

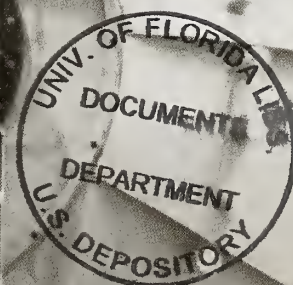
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ARMY

RESEARCH AND DEVELOPMENT

April 1972

SPEAKING ON . . .

Future Trends, Goals in Research and Development

Future trends and goals in research and development as viewed by Army Chief of R&D LTG William C. Gribble were presented when he recently addressed the Los Angeles Chapter, Association of the United States Army.

News media, he commented at the outset, normally carry only fragmentary information about the progress or failure of particular items of materiel—"Rarely does the civilian-at-large receive the opportunity of getting a look at the entire research and development package."

The remainder of his address, without any condensation, follows:



Research and development is many sided and many faceted. There are degrees and levels of research and there are degrees and levels of development. And, in a sense, each competes for our resources. In a larger sense, R&D must compete with the rest of the Army for available resources.

Each year trade-offs have to be made: Modernization versus maintaining a given level of forces in being; maintaining a given strength or devoting dollars to other needed areas; spend heavily for the future and allow the present to deteriorate.

The decisions do not come easily. They are made only after many, many long weeks of careful analysis and deliberation. The R&D program is a product of deliberate Army Staff review and coordination.

One could review the present Army R&D program in a number of ways. I could present it by descriptive summaries of our progress and status at the research level, the advanced development level, the engineering development and, last, operational systems development programs.

We could analyze the effort in terms of the technical base versus the development programs, or we could review it by the classic categories of firepower, mobility, and command and control.

Considering that your time is limited and for ease of handling then, I will address the scope of my remarks in terms of the four basic categories that we used in OCRD (Office of the Chief of R&D) to show where our money goes: Support of the technical base, resources devoted to strategic and joint programs, degrees of effort in Army tactical development programs and, last, what might be called the cost of doing business—the facilities and testing bill.

But before reviewing these four categories, I would like to set a frame within which to analyze each. This frame is composed of four factors that have and will continue to govern or control our program content and direction. These are:

- The threat and the materiel requirements derived therefrom.
- Available technology.
- Availability of funds.
- Other factors—political and international.

The threat has remained communist in nature since the late 1940s. It has taken various forms, from primarily nuclear to a more conventional armored threat to Western Europe, to the so-called "wars of liberation" of the Vietnam type.

As the accent shifted, so did the R&D emphasis. For example, the years of the primary nuclear threat caused an increase in missile activity. Then in the late 50s we strove to replace our first-generation family of missiles with the Pershing and Lance systems.

As our intelligence showed us the growing size and modernization of Soviet armored forces, Army R&D devoted an increasing amount of its resources to antitank systems.

With our commitment to operations in Vietnam, R&D had to shift resources toward counterinsurgency programs, and then to programs oriented to support U.S. operational requirements in Southeast Asia.

Lingering always in the background was the ominous cloud of Soviet ICBM (Intercontinental Ballistic Missile) capability—a capability that has influenced us to devote a major part of our resources to finding a means to counter or neutralize this threat.



LTG William C. Gribble Jr.

This part of the threat has not weakened. If anything, it has been strengthened.

Technology is the second influencing factor. The mid- to late 1960s were years of utilization of technological breakthroughs of the great surge of the late 50s and early 60s. Much of the equipment now in the hands of troops was born and matured in this period. The UH-1 Huey (helicopter) family and the TOW and Shillelagh missile systems are good examples.

With our increasing operational involvement in Southeast Asia, there was, of necessity, a decrease in the resources allocated to supporting the technological base—the long-term efforts—as we sought augmentation of efforts for the near-in developments for use in Southeast Asia.

As a result, our technology base today is weaker than we would like to see it. We have asked for and received for FY 72 a modest increase in funds to support this work. The years ahead would appear to be characterized by efforts on our part to maintain this level of effort in the face of rising costs and pressures to utilize defense dollars for other national purposes.

I do not foresee any major augmentation to our technology base resources. However, our progress will be productive, bringing to the fore another problem. We will be continually faced with more potential options to explore further than resources will support. We will have to dig deeper, earlier in the process, to get a better grasp of the potential before proceeding further.

The trend for the future, then, shows two characteristics or patterns: Greater selectivity of options pursued; and second, the necessity to prove out—an early corollary to the fly-before-buy approach to development.

The third factor is the availability of funds. For a decade and half R&D was virtually sacrosanct. Our R&D budgets rose yearly as national pride and the military threat generated full public support for R&D.

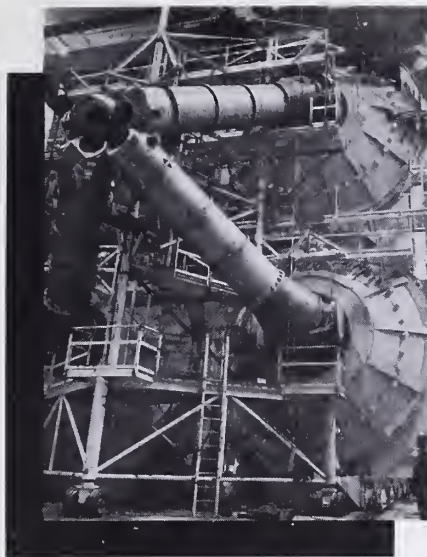
For a variety of reasons, the 69-70 period saw the start of a new climate. Most characteristic of this is the attitude and conduct of the Congress in the review of annual R&D budget requests. Congress no longer accepts us at face value, but inquires in greater scope and in far greater depth.

Dollars have always been a major consideration in determining the conduct of managing the Army R&D program as a whole, and in directing the prosecution of individual programs. However, in prior years there was an equally important consideration in program management—the attainment of program schedule milestones. A driving urgency to field needed systems was a major cause for this condition.

This was coupled with a philosophy that urged the big quantum job, technologically speaking. We and industry sometimes mislead each other, in that there were more technological "unknown unknowns" than we cared to anticipate. This was certainly one cause of the cost escalation and over-run problem that gave us problems.

The situation is now entirely changed. Dollars are the driving consideration in program management consistent with national security. All of the management changes undertaken by Secretary Laird and from (former) Deputy Secretary Packard, as well as

(Continued on page 46)



ARMY

RESEARCH AND DEVELOPMENT

Vol. 13, No. 2

March-April 1972

ABOUT THE COVER . . . For 100 billionths of a second, the radiation effects equivalent of more than 20 times the electrical power output from all the world's generating plants can be focused through the four diodes of the Defense Nuclear Agency's new Aurora Facility. The diodes are shown here as they converge at the exposure window for a pulse simulating the effects of nuclear radiation (gamma ray) upon electronic components of major weapons systems. The Aurora Facility is designed to lessen U.S. reliance upon underground testing of such components to learn how to "harden" them to assure performance of their mission if they, in reality, should be subjected to nuclear blast exposure. Rear cover shows complex circuitry in one of Marx generators.

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Selective Scanner . . .

CAS Tells U.S. Army of Australian R&D

Australion research and development (R&D) projects, technical papers, and product improvement of existing military military hardware are reported to the U.S. Army R&D community via the Current Awareness Service (CAS) of the U.S. Army Standardization Group, Australia.

Published periodically as fact sheets, the information provided by the CAS keeps interested agencies abreast of Australia's current military R&D activities. CAS also furnishes, as requested, additional information on specific projects.

Australia's Department of Supply, to which the CAS is accredited, accounts for the major portion of that country's R&D capability. With a staff of 21,000, of which 1,500 are graduate scientists and engineers, Supply is the largest of the Commonwealth Departments. It supports Army, Navy and Air Force research and development, purchasing, production, transport and storage activities related to Australia's defense needs and to fulfill commitments under international agreements.

AVSCOM to Improve Chinook Engine

A product improvement program for the T55 series gas turbine engine which powers the Army's CH-47 Chinook helicopter is being initiated by the Army Aviation Systems Command (AVSCOM), St. Louis, Mo.

Awarded a \$1,518,685 cost-plus-a-fixed-fee contract, the Lycoming Division of AVCO Corp. will handle the program for the Army through December of this year.

Australia Tests Pilotless Target Drone

Turana, a high-speed pilotless target drone designed for use by the Royal Australian Navy, was flown successfully during a recent 19-minute flight trial. Reaching an altitude of 10,000 feet and a speed of over 450 mph, the drone carried out a number of complex maneuvers under radio command from the Waamara Missile Range in Australia.

The U.S. Army Standardization Group, Australia, reports that the drone could be used with a tow sleeve as a variable speed service practice target.

Teflon Patch Repairs Heart Ventricle

What is believed the first successful repair of a ruptured heart ventricle, until now always fatal to its victims, was announced recently at the U.S. Army William Beaumont General Hospital, El Paso, Tex. LTC (Dr.) Ferdinand J. Montegut, MC, has brought hope and happiness to a 59-year-old retired Army officer while making medical history in closing the rupture with a special teflon felt patch. The patient, first to survive this defect, is today active and showing no symptoms of heart disease — a year after the surgery.

AMMRC Develops Small Tensile Tester

With more brittle materials being used in designed structures, it is becoming increasingly critical to know as much as possible about their mechanical properties.

The Army Materials and Mechanics Research Center, Watertown, Mass., has developed a simple, inexpensive tensile test system which provides accurate tensile strength data on brittle materials.

Composed of a hollow cylinder into which the specimen is placed, the tester is approximately 2½ inches in diameter and 7½ inches long.

Oil Samples Study Protects Aircraft

Examining oil samples is helping the Army Aviation Test Board, Fort Rucker, Ala., detect excessive wear in helicopter and airplane engine components, leading to prompt grounding as necessary. Chemists and technicians in the "Oil Lab" analyze samples to determine concentration of 7 different wear metals.

These concentrations, and the rate of increase between samples, indicate the condition of engine components.

Since 1961 "Oil Lab" recommendations have resulted in replacement of some \$24 million worth of engine components — which is just a small fraction of what is involved when an aircraft engine fails in flight, especially in terms of human lives.

Test Pilots Evaluate Cheyenne at AVSCOM

Six Army test pilots, whose cumulative total flight time exceeds 30,000 hours, recently met at the Aviation Systems Command, St. Louis, Mo., to discuss the results of the AH-56A Cheyenne Test Program. Meeting with BG Henry H. Bolz, Jr., Advanced Aerial Weapons Systems project manager, the pilots reported on their flight experience with the Cheyenne and commented on its potential. To date, the AH-56A has been taken to airspeeds up to 234 knots with a gross weight of 18,300 pounds. Weapons on the craft have also been tested. Other tests are scheduled to be made this year at Hunter-Liggett Military Reservation, Calif., and Yuma Proving Ground, Ariz.

CDC Develops Airborne Loudspeaker

The Combat Developments Command (CDC) has disclosed an airborne loudspeaker system called ALOUD, consisting of a double-bank of speakers and amplifiers mounted in the UH-1H (Huey) helicopter.

Designed to broadcast messages in psychological warfare and civil operations, ALOUD was tested recently at Fort Ord, Calif. Using 4-man listening teams of surveyed positions, levels of reception during different flight-and-altitude combinations were checked on the ground along a 66,000 meter course.

CDC researchers envision time and life-saving civil applications of ALOUD for natural disasters, riots, traffic tie-ups and other situations requiring immediate communication.

Spectrometer Reveals Explosives Impurities

Research chemists at the Feltman Research Laboratory, Picatinny Arsenal, Dover, N.J., are investigating impurity profiles in explosives with a spark source mass spectrometer. Termed a dramatic advance in the field of ultra-trace analysis, giving the arsenal a unique capability, the spectrometer enables researchers to determine impurities in solids and their effects on the behavior of explosives.

Potential value of this technique was first demonstrated by Dr. Bruce Dhanoy of Bell Labs in 1946. Only since the recent availability of double-focusing, mass-resolving instruments with both photographic and electrical detection has the technique attained its important status as a trace analytical tool.

Department of Defense Mapping Combined

The U.S. Army Topographic Command and the Department of Topography of the U.S. Army Engineer School are two of the tri-service mapping agencies to be incorporated into the Defense Mapping Agency (DMA) as a separate agency of the Department of Defense. LTG Haword W. Penney was appointed as the first director of the new agency.

MICOM Employees Design Hydrostatic Gyro

Inventors Aubrey Radgers (left) and Royburn Widner look over the hydrostatic gas-bearing gyro they designed and fabricated at the U.S. Army Missile Command (MICOM), Redstone Arsenal, Ala. Expected to be more reliable, less expensive and faster reacting than others in use today, it has fewer working parts than other gyros and a single power source for spin, uncage repeatability, and bearing.



Operation of the gyro begins when pressurized gas is introduced into a spherical stator which expels it through restrictors, forming a gas film between the stator and the spherical rotor cavity. Almost simultaneously, cold pressurized gas energizes the spin-up mechanism.

The rotor is accelerated very rapidly to the design speed and automatically uncages when the spin-up gas is exhausted. At that point, the gyro is operational and pickoff signals can be used to provide attitude information. MICOM researchers say the gyro could be used in any directional control missile such as Lance or D.C. Honest John.

New Welds To Be Used for Orbiting Telescope

A prototype support system, using the largest all-welded titanium alloy structure ever made, is being developed for an orbiting double-mirror telescope the National Aeronautics and Space Administration (NASA) expects to launch during the 1970s.

Planned for a "parking" orbit some 400 miles above the earth's surface, the telescope will permit a study of the universe without distortion from the earth's lights and atmosphere. Information will be relayed to earth by electronic telemetry as well as by astronauts using space-shuttle vehicles.

The "I" beams of the primary mirror support—one of two major parts of the support system—were fabricated by a welding procedure developed by Bottelle-Columbus Laboratories in a program for the Air Force Materials Laboratory three years ago.

When the prototype system is completed, NASA will evaluate the structure, subjecting it to loadings in simulated launches to determine how it expands, contracts and warps.

Services Join in Container Systems Testing

The Army, Navy and Marine Corps are planning to conduct an investigation of the best available equipment and techniques for unloading sea-van containers from anchored container-ships during the Off-Shore Discharge of Container Ships (OSDOC II) evaluation.

The test, which is under the over-all coordination of the Department of Defense (DoD) project manager for surface container systems, will be conducted at Fort Story, Va., during September or October 1972.

The surface container systems project, aimed at developing a totally integrated containerized distribution capability applicable DoD-wide, is expected to realize early benefits from this test.

Since it will investigate one of the thorniest problems facing the project manager, the determination of optimum means of moving containers in the logistics over-the-shore (LOTS) environment using readily available equipment, the test is considered extremely important.

New container lifting equipment and beach handling equipment, including large mobile cranes, will be evaluated. The emphasis during the test will be on the use of surface equipment, since the United States will not have a helicopter capable of lifting a fully loaded sea-van container in the near future.

Deseret Studying Safer Pest Control Agents

An ever-increasing role in pest control programs is being taken over by organophosphorus compounds (Parathion, Malathion, Guthion, DDVP, Systox), according to data compiled from the Deseret Test Center, and Fort Douglas, Utah.

Considered safer for wide-scale use than chlorinated hydrocarbons (DDT, Dieldrin, Methoxychlor, Toxaphene, Chlordane, Aldrin), organophosphorus compounds decompose more rapidly in the environment.

Deseret Test Center researchers estimate that in 1970 alone 182,101 pounds of organophosphates were used for agricultural, domestic, commercial and mosquito abatement programs in Utah, compared with 61,918 pounds of chlorinated hydrocarbons.

However, while present evidence suggests that these pesticides break down more rapidly, they can still be dangerous to fish, birds, and mammals, including man, when improperly used.

For this reason, Army personnel at the Deseret Test Center have started a monitoring program to detect organophosphates in Utah's waters. The purpose is to prevent a buildup to levels where fish kills may result or wildlife and livestock using the water as a drinking source could be endangered.

MERDC Names Women's Program Coordinator

Appointment of Miss Muriel J. Cole as Federal Women's Program Coordinator for the U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Mo., has been announced.

COL Bennett L. Lewis, MERDC commander said Miss Cole will coordinate the center's policy and activities related to equal employment for women. She will assist in the development of the Equal Employment Opportunity (EEO) plan of action to assure it fully meets the center's objectives.

Miss Cole will serve as agency representative in consultation with public and private groups and individuals concerned with improvement of employment opportunities for women. She will also make special studies and surveys of employment patterns to identify weaknesses in management activities hindering full attainment of equal opportunity for women.

Miss Cole's new assignment is in addition to her regular position as a management analyst in the Management Division of the Comptroller's Office and as RECON (Resources CONservation) coordinator for the center.

Bowfin Fish Raises Pollution Suspicion

A Bowfin fish, caught in the tidal waters of the Gunpowder River near Aberdeen Proving Ground, Md., has given rise to speculation of undesirable ecological changes in Chesapeake Bay.

Never before reported in the Maryland portion of the Bay, this species can live in heavily polluted or oxygen deficient waters, according to 1LT James G. Pearson, fish physiologist at Aberdeen Proving Ground.

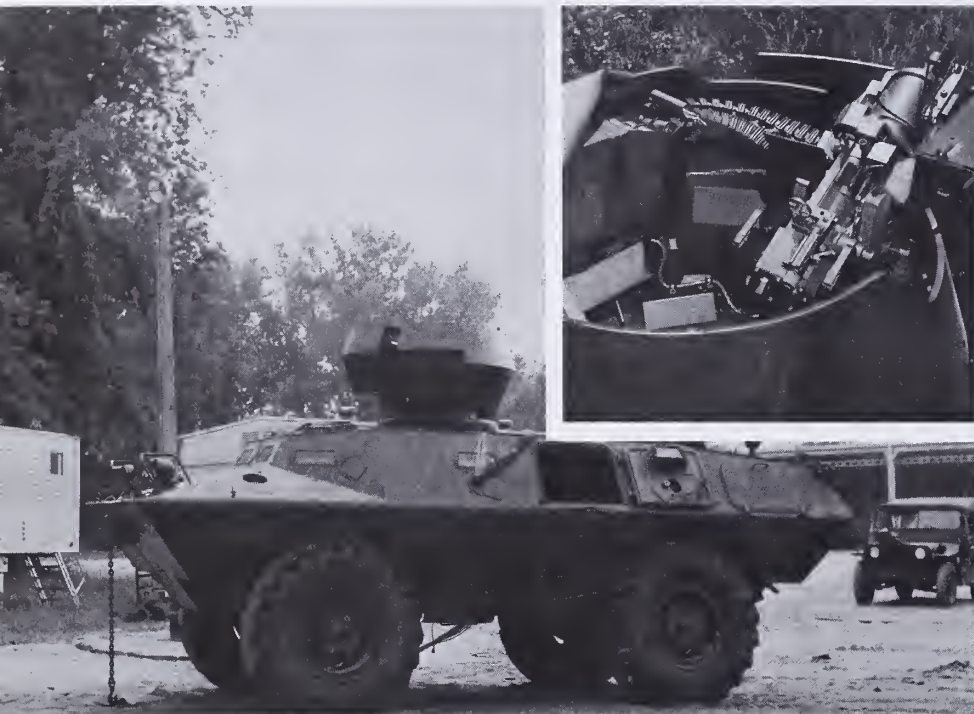


"This find," he said, "along with the re-emergence of the brookish-water clam in the 1960s indicated to me that undesirable ecological changes are probably taking place in the Bay."

The Bowfin has been donated to the University of Maryland's Chesapeake Biological Laboratory at Solomons Island, Md.

ACTIV Revising Its Mission . . .

After nearly a decade of rapid response to urgent U.S. Army needs, Army Concept Team in Vietnam turns to Vietnamization



While development of the XM182 grenade launcher system (shown on this page) was an ENSURE project, this particular modification for use with the Armored Escort Car (above) was completed under VLAPA. Three of these systems were modified to adapt to the XM706E1 Armored Escort Car (Commando) used by the Military Police in Vietnam in their convoy escort role. A close-up of the modified system is shown at top.

Nearing a decade of operation in Vietnam, the ACTIV (Army Concept Team in Vietnam) is shifting its research and development (R&D) functions to meet the needs of Vietnamization.

Since 1962, when it was formed as an evaluation agency, ACTIV has appraised new or improved Army operational and organizational concepts, doctrine, tactics, techniques, procedures and materiel.

During this time, many of its recommendations for improving combat effectiveness of Army units have been adopted. These relate not only to U.S. troops but to those of the Republic of Vietnam (RVN) and the Free World Military Assistance Forces (FWMAF) as well.

Expanding its role in September 1969, ACTIV was assigned additional missions supporting R&D. From that date, the agency coordinated and managed all U.S. Army R&D activities in the operational environment of Vietnam.



ANOTHER ENSURE PROJECT is this remote ground unit locating device—an elevated site-marker balloon, developed to enable aircraft to locate friendly ground units operating under the jungle canopy of Vietnam. When filled with helium, the balloon works its way up through the dense jungle brush, rising until it can be seen by friendly aircraft for dropping supplies.



This pintle-mounted grenade launcher, an ENSURE project, resulted from a requirement early in the Vietnam conflict for a special weapon to be used with the M113 APC to engage area targets. Designated the XM182 high-velocity 40mm grenade-launcher system, the weapon filled the gap between the .50 cal. machine-gun and various other larger infantry weapons.

Serving as the point of contact between the Military Assistance Command, Vietnam (MACV) and Department of the Army (DA), ACTIV also took on responsibilities for combat development (CD) and materiel evaluation (ME).

A staff of 16 officers and 18 enlisted personnel in Saigon, commanded by COL William K. Marr, also compiles, analyzes and publishes U.S. Army concepts and techniques on Vietnam operations.

Consisting of three divisions—R&D, Evaluation, and Operations—ACTIV is augmented by five representatives from the Army Materiel Command's (AMC) commodity commands and three contractor personnel involved in Operations Research and Systems Analysis.

This is the first instance of a separate agency being assigned to an Army field command as the point of contact to both AMC and the Combat Developments Command (CDC). ACTIV serves both as a staff element of U.S. Army, Vietnam (USARV) and as a separate unit conducting and supervising operational evaluations.

Contact with HQ Department of the Army is thru the ACTIV Liaison Group, a Class II activity assigned to the Office of the Assistant Chief of Staff for Force Development (ACSFOR).

Two of the Army's major development programs in support of combat operations in Vietnam are administered by ACTIV, which also monitors all Land Warfare Laboratory (LWL) projects there.

One is ENSURE (Expedited, Non-Standard, Urgent Requirement for Equipment). The other is VLAPA (Vietnam Laboratory Assistance Program, Army).

ENSURE was established by the Department of the Army to deliver both off-the-shelf and developmental nonstandard materiel to meet the urgent requirements of combat troops in Vietnam with a "minimum of red tape." It is also being used by the Eighth U.S. Army in Korea, the Continental Army Command (CONARC), and MASSTER (Modern Army Selected Systems Test, Evaluation and Review organization).

Equipment delivered to Vietnam under this program has ranged from commercial items, such as chain saws, to R&D projects like the Forward-Looking Infrared (FLIR) system for Army night-attack helicopters.

More than 370 ENSURE projects have been initiated during the Vietnam conflict. Projects have involved both the development and procurement of nonstandard items. The time between submission of a request and receipt of an item has ranged from 6 months to 5 years for R&D items, and 3 to 12 months for those procured.

Recently, an ENSURE project was approved for ARVN under the Vietnamization Program. It involves a bulldozer kit for the M113/A1 armored personnel carrier (APC) which gives the vehicles so equipped a bulldozing capability.

ENSURE works this way. When urgent operational needs dictate, field commanders, as authorized by ACSFOR, submit requests for nonstandard equipment. The item might require development, or could be obtained off-the-shelf. An overriding criterion is the ur-



Sniperscope Mounted on M-14 Rifle

gency expressed by the requesting commander.

Following USARV staffing by the ACTIVE R&D Division, ENSURE requests are submitted through U.S. Army Pacific (USARPAC) to the Department of the Army. When approved, funds are allocated for the projects. Availability of the equipment determines whether items arrive in the field within a few months (chain saws) or several years (FLIR).

The VLAPA program is designed to solve engineering problems in the field in less than nine months at a cost not exceeding \$50,000 per project. To date, of 111 requests for such improvement, 75 have been approved.

AMC representatives with ACTIV work in the VLAPA program. They are rotated every three to six months on a temporary duty (TDY) basis, coming from: Munitions Command (MUCOM), Dover, N.J.; Tank-Automotive Command (TAQOM), Warren, Mich.; Weapons Command (WECOM), Rock Island, Ill.; Mobility Equipment Command (MECOM), St. Louis, Mo.; Electronics Command (ECOM), Fort Monmouth, N.J.

Typical VLAPA projects have included: plastic covers for cartridge cases, dust covers for rocket launchers, improved tires for certain Army vehicles, storage racks, training aids for mine detector operators, disposable food containers, and many more.

During the past year, 25 projects under VLAPA were submitted for ARVN or both U.S. and ARVN troops, as part of the shift to Vietnamization. This contrasts with the earlier VLAPA program geared entirely to U.S. Forces. Currently, VLAPA representatives spend about 80 percent of their time with the ARVN.

ACTIV's future role is being studied. In reviewing the accomplishments of this agency and its usefulness, the evaluation is expected to outline the missions and responsibilities an organization of this type should have in the years ahead. Findings will determine where and when ACTIV should be employed; also, how and at what level it should be organized.

Whatever the outcome of the study, responses to field Army needs during the past ten years have gained general acclaim for ACTIV as an effective organization fulfilling significant responsibilities.

FIBROUS CONCRETE

'Hot' Material for Airfields

Fibrous Concrete: Construction Material for the 70s is the topic of a May 1-3 conference expected to draw 300 or more concrete experts to discuss what is termed "one of the hottest" Army research and development advances in recent years.

Credited currently with a leading role in developing fibrous concrete technology to the point of this national and international interest is one of the newest of the U.S. Army's major R&D facilities—the Construction Engineering Research Laboratory, the conference site.

Located on the campus of the University of Illinois at Champaign, CERL was dedicated July 24, 1969. Operating in facilities leased from the University of Illinois Foundation, CERL was staffed initially with a nucleus of personnel transferred from the Army Corps of Engineers Ohio River Division Construction Laboratory.

CERL's function as a research center of national importance, when fully staffed with about 260 highly skilled personnel, will be comprehensive. Primarily, it is directed to improving military and civilian construction technology by R&D of new materials and methodology.

The mission includes establishment of a national computerized data bank on construction research information that will be available to all federal and local government agencies, and the construction industry. The concept is that of "total systems" construction technology, as applied to Corps of Engineers military and civil works projects.

Greatly stimulating the current interest in fibrous concrete is a recent report on CERL tests performed in conjunction with plain concrete pavement studies at the U.S. Army Waterways Experiment Station, another Corps of Engineers facility at Vicksburg, Miss. Results showed remarkable durability and strength of fibrous concrete for airfields.

(continued on next page.)



ARTIST'S SKETCH of C5A showing landing gear complex



PHOTO ABOVE shows the condition of 10" plain concrete pavement after 700 loadings of simulated C5A traffic. Shown below is 6-inch fibrous concrete subjected to the same tests.



LOADING APPARATUS used to simulate stress of C5A traffic



Laboratory and field demonstrations of the qualities of fibrous concrete will highlight the May 1-3 conference. Dr. Gordon Babson of Clarkson College, Potsdam, N.Y., will be a featured speaker as chairman of the American Concrete Institute FC committee.

Prof. Clyde Kesler of the University of Illinois, a past president of the American Concrete Institute, along with Dr. James Lott, John Rice and Bobby H. Gray, all of CERL, are programed among the leading speakers.

Gray, CERL's project manager for fibrous concrete, was in Washington, D.C., during the last week of February to explain testing results and other developments to officials of the Federal Aviation Administration, the Naval Security Command, and the Office of the Chief of Engineers, Department of the Army.

In the Waterways Experiment Station test program, fibrous-reinforced and plain concrete pavements were subjected to simulated loadings of the C5A aircraft.

Fibrous pavement, only half as thick as the regular pavement, withstood twice as many load applications. When the regular pavement was virtually destroyed, the fibrous pavement still had useful life.

With a gross weight of three-quarters of a million pounds, the C5A is designed with flotation which permits it to be used on medium-load airfields. The plane has three landing gears with 12 wheels on each of two main gears, and four wheels on the nose gear.

The fibrous concrete used in the test contained a random dispersion of steel fibers an inch long and 16 millimeters in diameter. The fibers serve to restrict the growth of flaws in the concrete matrix from enlarging under stress into visible cracks which ultimately cause failure. By restricting the growth of cracks, the usable tensile strength of the concrete matrix is increased to a usefully predictable level.

The tests were performed with one 12-wheel gear loaded with 30,000 pounds per wheel. To simulate a reasonable distribution of traffic, loads were applied sequentially along five evenly spaced parallel lines, across an area 200 inches wide.

After 700 loadings, the plain concrete pavement was reduced to a shattered condition. Very few hairline cracks appeared in the fibrous concrete after 1,400 loadings but many developed after 4,500 loadings. However, the pavement did not fail since the load was transferred across the cracks through the fibers.

To increase the strength of the plain pavement which shattered at 700 loadings, a partially bonded fibrous concrete overlay, less than half the thickness of the original pavement, was applied.

The first hairline crack occurred at 700 loadings. Only after 3,200 loadings were several hairline cracks apparent. This performance, approximating that of fibrous concrete placed directly on subgrade, is attributed to the ability of the fibers to retard cracks in the original pavement from reflecting through to weaken the overlay.

In the current investigations at WES, the fibrous concrete slab, 25' x 50', is at the east end of a 320-foot-long test section. It rests on a 4-inch-thick sand

filter course and is 6 inches thick, with the east and west edges thickened to 9 inches by a uniform taper for a 30-inch length. This reduces the free edge stress to an acceptable level.

Prior to overlaying, the 10-inch-thick base pavement was in a completely failed condition after being subjected to the 700 loadings of simulated C5A traffic. Major structural cracks and severe spalling were present.

HISTORICAL BACKGROUND. Fibers have been used to reinforce brittle materials since ancient times, and have been produced from steel, plastic, glass, asbestos and cotton materials in various shapes and sizes.

In early days, straw was used to reinforce sun-baked bricks, and horse hair to reinforce plaster. Currently, asbestos fibers are used to reinforce Portland cement.

Since the turn of the century, patents have been granted for various methods of incorporating wire segments or metal chips into concrete. Use of reinforcing rods in the tensile zone has compensated for the low tensile strength of concrete since the 1950s.

Research on random steel fibers to strengthen concrete was first conducted by J. P. Romualdi and G. B. Batson under a National Science Foundation grant in the 1960s. Their work was first described in a paper titled "The Mechanics of Crack Arrest in Concrete," in the Journal of the American Society of Civil Engineers.

They were also coauthors of "The Behavior of Reinforced Concrete Beams with Closely Spaced Reinforcement," American Concrete Institute Journal (1963).

A third scientist, J. A. Mandel, coauthored with Romualdi a study on "Tensile Strength of Concrete Affected by Uniformly Distributed and Closely Spaced Short Lengths of Wire Reinforcements."

Based on the work of these three men, a U.S. patent royalty free to U.S. Government was granted in the late 1960s. Since then considerable research has been done.

U.S. Army engineers have been investigating, since the early 1960s, practical applications of fibrous concrete for military construction. The current effort was transferred to CERL from the Ohio River Division Laboratories (ORDL), Cincinnati, Ohio. CERL's efforts have concentrated on assessment of the applicability of fibrous concrete as a paving material.

Some of the behavioral properties of fibrous concrete highly favorable for pavement applications are: the high first-crack strength, post-crack-load carrying capacity, and high spall resistance.

Advantages anticipated from these characteristics include thinner pavements, greater load-carrying capability of cracked sections, and less danger of spall debris.

As the construction agency for Air Force as well as Army airfields, CERL is interested in accommodating pavements to the jumbo jet age. Using fibrous concrete, this goal becomes realistic in that the material retards deterioration, extends the service life, and should require less maintenance than conventional concrete.

CERL's recent test results suggest an economical way of ultimately upgrading every military and civilian airfield in the United States.

Troops List Their Food Choices . . .

Experiment at Fort Lewis, Wash., provides insight into reasons why soldiers slight messhalls, offers preferential basis for menu change

When the U.S. Army spends about \$2 billion annually to provide the most nutritious and appetizing food possible, considering the limitations of a mass-feeding environment, why do about half the soldiers prefer to pay for their meals in private eateries? What can be done to correct this by catering more to their preferences?

Based upon findings to the first question in a recently concluded experiment at Fort Lewis, Wash., conducted in conjunction with researchers from the Army Natick (Mass.) Laboratories, efforts are under way to respond satisfactorily to the second query.

Resources of the Fort Lewis post and the NLABS were pooled to test a new concept of feeding during a 60-day experiment termed CAFE (Centralized Army Feeding System). The concept involves central preparation of food, rapid chilling, and transportation as needed to satellite dining halls to be reconstituted and served.

An important consideration in revising the present feeding system is to help ease the problem of achieving high morale in meeting requirements for the Modern Volunteer Army recruitment program. Improving the quality and acceptability of the food is the prime objective, but another key goal is reducing cost of the over-all operation.

During the first Fort Lewis experiment to learn some of the causes why nearly 50 percent of the soldiers entitled to free meals preferred to eat elsewhere when possible, even at their own expense, their likes and dislikes were tabulated. Comparisons were made on the Army's 9-point hedonic scale, a preference yardstick ranging from 1 (disliked extremely) to 9 (liked extremely) which has been used in previous food preference surveys.

Consisting of 416 randomly listed food items taken from the Armed Forces 42-day menu, the survey resulted in food ratings that were used in conjunction with the new feeding system.

Of the 573 troops comprising the final sample, 301 also took part in a Consumer Attitude Survey. The latter, a comprehensive questionnaire, was designed to learn which factors best predict and explain attendance at messhalls.

The two surveys were correlated to permit a detailed analysis of the relationship between dining hall attendance, frequency of food item choice, and personal "background" factors (such as age, education, attitude toward military service, etc.).

The preference study, directed by Dr. Herbert L. Meiselman, head of the Food Acceptance Group of Natick's Pioneering Research Laboratory, involved home economists, and food and behavioral scientists.

Among a number of conclusions, the survey showed that soldiers love pizza but did not want it as often as it was served—and that they disliked cauliflower but would be willing to eat it more often than it is now served. Milk products, ice creams, breads and rolls, and breakfast meats were the most popular food sub-classes.



SOLDIERS at unit dining facility. Food is prepared in central kitchen.

A striking finding was the large number of foods being served on the Armed Forces menu, or planned for future adoption, which are unpopular. Some are traditional problem foods: liver, certain vegetables and casseroles. Others, such as soups and salads, were shown to be relatively unfamiliar problem foods. Fruit and vegetable juices, carbonated beverages, and hot beverages, while accorded only moderate hedonic ratings, were desired with high frequency.

Researchers also learned that: soldiers want basic, unadorned foods much more than elaborate dishes; soups and sauces are a drag; and quick foods, like burgers and milkshakes, are consistently popular.

Their preferences had much to do with the CAFE experiment which included short order only and specialty (Italian, seafood, or Mexican foods) dining halls, as well as those serving both entrees and short orders, and entrees only.

These were garrison satellite dining halls supported by the central kitchen and sanitation facility. They included a field satellite dining area with the short order and specialty houses.

Automation came into further play during the experiment with CAFE's use of an embossed plastic credit card for automated head-

count. This was tried to eliminate an "irritant" to today's military man, the requirement for his signature on the headcount sheet before being allowed to eat.

The card, containing the individual's name, was simply inserted into a slot for automatic headcount. If eventually adopted for Army-wide use, this could be the first credit card ever issued to soldiers.

All data obtained from the food preference survey resulted in the menu changes used in the CAFE testing. Highly preferred vegetables such as corn, green beans and peas replaced the less preferred asparagus, lima beans, and succotash. Low preference main dishes such as beef liver, oysters, and sauerbraten were removed in favor of dishes like chicken, a much preferred item.

Menu changes like these, and the techniques of preparing and serving foods as were tested in the CAFE experiment are all aimed at making a varied and acceptable menu available at every meal and, hopefully, of increasing messhall attendance.

It remains to be seen if these goals can be reached. In the meantime, the food preference surveys and the feeding experiment just completed are being evaluated as part of the Army's continuing effort to improve service life for its members.

COMPILING DATA obtained from Fort Lewis, Wash., and Natick (Mass.) Laboratories, "Nation's Restaurant News" published charts in its Jan. 3, 1971 issue which are reprinted on page 9. They show the choices made by troops for main dishes, desserts, vegetables, salads, potatoes and starches, and beverages.

Main Dishes (PREFERENCE)

		Low	Moderate	High		
FREQUENCY	Low	A. Sardines D. Liverwurst	D. Cervelat			
	Moderate	A. Fried Oysters C. Beef Liver	A. Fish Shrimp Creole Breaded Shrimp Tuna Salad Seafood Platter Baked Tuna & Noodles Lobster Lobster Newburg Salmon B. Baked Macaroni & Cheese Lasagna C. Lamb Roast Polish Sausage Lamb Chops Veal Roast	Spare Ribs & Sauerkraut Corned Beef BBQ Beef Cubes Veal Parmesan C. Veal Burger Breaded Veal Steaks Baked Stuffed Pork Swedish Meat Balls Pepper Steak Italian Sausage Chili Con Carne Chili Con Carne/Beans D. Bologna Frankfurter Salami	Sloppy Joe Turkey Club Sandwich Submarine Sandwich Luncheon Meat (c.c.) Ham (c.c.) Chicken Club Sandwich Turkey (c.c.) Meatball Submarine D. Tacos Western Sandwich Shredded Beef w/BBQ Sauce Fish Sandwich Hot Tamales	B. Pizza Spaghetti Ravioli Chili Macaroni C. Ham (canned) Sliced Roast Pork w/gravy Roast Pork Ham Pot Roast BBQ Spare Ribs Meat Loaf Cheeseburger Cheese & Ham Sandwich Hot Roast Beef Sandwich
	High				C. Roast Beef Swiss Steak Grilled Steak Salisbury Steak Fried Chicken Turkey	Chicken Turkey, sliced w/gravy D. Hamburger Pizza

Desserts (PREFERENCE)

	Low	Moderate			High	
FREQUENCY	Low	Molasses Cookies Raisin Pie	Coconut Raisin Cookies Butternut Refrigerator Ginger Molasses	Chewy Nut Bars Crisp Toffee Bars Chocolate Chip Bread	Peanut Butter Cake Custard Pudding Sauce Pineapple Sauce	Apricot Pie
	Moderate	Mincemeat Pie	Sugar Cookies Hermits Lemon Cookies Vanilla Wafers Fruit Bars Raisin Drop Cookies Peanut Butter Cookies Coconut Drop Cookies Chocolate Drop Cookies Oatmeal Cookies Bread Pudding Cherry Cake Pudding Chocolate Cream Pudding Vanilla Cream Pudding Lemon Cake Pudding Chocolate Pudding Butterscotch Pudding	Banana Cream Pudding Chocolate Coconut Pudding Applesauce Cake Fruit Cake Spice Cake Chocolate Chip Chocolate Cream Cake Cherry Pie Devil's Food Cake Marble Cake Banana Cake White Cake Pineapple Upside Down Cake Raspberry Shortcake Peach Shortcake	Yellow Cake Lemon Pudding Sauce Vanilla Pudding Sauce Hot Fudge Sauce Butterscotch Sauce Lemon Chiffon Pie Blackberry Pie Pineapple Chiffon Pie Boston Cream Pie Banana Cream Pie Boysenberry Pie Pineapple Pie Strawberry Chiffon Pie Coconut Cream Pie Peach Pie Blueberry Pie	Chocolate Cream Pie Pineapple Cream Pie Pumpkin Pie Butterscotch Cream Pie Lemon Meringue Pie Sherbet Apricot Crisp Peach Crisp Brownies Ginger Bread Apple Crisp Butterscotch Brownies Cherry Crisp Strawberry Gelatin Applesauce, Instant Fruit Cocktail
	High					Strawberry Shortcake Apple Pie Banana Split Soft Serve Ice Cream Milk Shake Ice Cream

Vegetables (PREFERENCE)

	Low	Moderate	High
FREQUENCY			
Low	Mustard Greens Zucchini Squash Egg Plant Succotash Rutabagas Turnip Parsnips		
Moderate	Brussels Sprouts Okra*** Waxed Beans Cooked Onions Beets Turnips	Lima Beans Asparagus Canned Peas Canned Green Beans Peas Broccoli Spinach Cabbage Carrots Yellow Squash** Peas & Carrots	Radishes Canned Tomatoes Stewed Tomatoes Black-Eyed Peas French Fried Onion Rings Sauerkraut
High		Green Beans Creamed Style Corn	Corn, Sliced Tomatoes Mixed Vegetables Corn-on-Cob

Salads (PREFERENCE)

	Low	Moderate	High
FREQUENCY			
Low	Cabbage & Sweet Pepper Salad Pineapple Cheese Salad Carrot Salad Kidney Bean Salad Carrot, Raisin & Celery Salad Frijole Salad Pickled Green Beans Salad		
Moderate	Waldorf Salad Pickled Beet & Onion*** Cucumber, Onion, Sweet Pepper Salad Cucumber & Onion Salad	Banana Salad Assorted Fruit Salad Cottage Cheese & Fruit Salad Mixed Fruit Salad Cole Slaw Tossed Cucumber & Tomato Salad	Garden Cottage Cheese Salad Vegetable Slaw Potato Salad Macaroni Salad Chef's Salad
High		Lettuce Salad Jellied Fruit Salad Lettuce & Tomato Salad Tossed Vegetable Salad	Tossed Green Salad

Potatoes & Starches (PREFERENCE)

	Low	Moderate	High
FREQUENCY			
Low		Rice Pilaf	
Moderate	Scalloped Potatoes Sweet Potatoes Mashed Potatoes, Instant Baked Potatoes Potato Salad Noodles Lasagna Macaroni Salad Ravioli Chili Macaroni Boston Baked Beans Beans/Pork in Tomato Sauce Rice	Fried Rice Spanish Rice Fritters	Potato Chips Hashed Brown Potatoes Spaghetti
High			French Fried Potatoes Mashed Potatoes

Beverages (PREFERENCE)

	Low	Moderate	High
FREQUENCY			
Low	Iced Coffee		
Moderate	Freeze Dried Coffee	Instant Coffee Grape Lemonade Grapeade Orangeade Limeade Lemon-Lime Soda Tea	Fresh Coffee Iced Tea Fruit Punch Gingerale Grape Soda Cherry Soda Imitation Cherry Imitation Orange Imitation Lemon Orange Soda Imitation Lime Imitation Grape
High			Hot Cocoa Cola Beer Lemonade Milk Chocolate Milk Milk Shakes

SATCOM AGENCY . . .

Reports on the Significant Advances In Defense Satellite Communications



Development and deployment of earth terminals in the Defense Satellite Communications Program advanced significantly during 1971, according to a progress report issued by the U.S. Army Satellite Communications (SATCOM) Agency, Fort Monmouth, N.J.

One of the major advances was installation of a technologically improved terminal on the West Coast test site of a contractor under a \$7.9 million award. It will serve as a prototype for future terminals.

Designed for greater reliability, flexibility and capacity, the terminal is being tested for use with newer, more

powerful satellites now under development.

Phase I of ground terminal research and development has provided the Department of Defense a worldwide communications network since 1967. This initial phase utilized 23 low-power satellites drifting slowly in orbits nearly synchronous with the earth's rotation, and 29 earth terminals deployed globally.

Last year, the SATCOM Agency undertook a terminal modification program to allow an orderly transition from Phase I to Phase II of the Defense Satellite Communications System. This called for design and fabrication of 29

communications subsystems to expand capabilities of existing earth terminals and permit their use with the new satellites.

Along with this development, the launching of two new military communications satellites from Cape Kennedy in November 1971 marked the first step in implementation of Phase II. The SATCOM Agency began earth terminal performance tests through the two satellites shortly after they went into orbit about 22,000 miles from the earth.

The Army's mission of developing and deploying earth terminals is assigned to the SATCOM Agency, while the Air Force is responsible for developing and launching satellites of the Defense Satellite Communications System.

An additional Army responsibility was taken on by the 235th Signal Detachment, U.S. Continental Army Command (CONARC), which was activated last year to assume operational control of tactical satellite communications terminals designed and developed under the technical direction of the SATCOM Agency.

The unit is made up of officers and enlisted personnel formerly assigned to the SATCOM Agency's Test and Evaluation Directorate. From its field station at Lakehurst, N.J., the 235th will man the terminals in operations directed by the Joint Chiefs of Staff, in field exercises conducted in the U.S. and overseas, and for equipment demonstrations of major commands of the Armed Services.

The tri-service SATCOM Agency is continuing research and development on other tactical satellite communications terminals. Highly mobile, these terminals can be carried by 3-man communications teams, transported by jeeps and $\frac{3}{4}$ -ton trucks, or mounted on helicopters. The terminals are small and can be set up quickly, thus lending themselves to battlefield situations.

They have already been tested in field exercises. In EMBER DAWN conducted in Alaska, SATCOM Agency soldiers used two teampack terminals and two mounted on jeeps to establish a command communications network for maneuver elements.

Again, in REFORGER III, an annual NATO exercise, SATCOM teams provided communications between field headquarters in Germany and 1st Infantry Division headquarters at Fort Riley, Kans., using five tactical terminals.

The SATCOM Agency, as the Army project manager organization for all Department of Defense tactical and strategic ground environment satellite communications programs, is thus charged with an important role in the nation's space research and development program.

Technological Pace Quickens . . .

WRAIR Reactor Gives Way to Nuclear Progress in 9 Years

Nine years after its dedication as a medical investigative tool of "great significance," the 50,000-watt nuclear reactor at Walter Reed Army Institute of Research has yielded to the pace of technological progress.

Dismantling of this facility—dedicated Sept. 12, 1962, as the main feature of a new wing to WRAIR opened simultaneously for inspection by an exceptionally large gathering of medical dignitaries—was completed shortly before arrival of 1972.

Dedication speakers acclaimed the reactor as an epochal advance in expanding biological research capabilities of the U.S. Army—in line with the first carefully formulated 5-year program planned to provide medical know-how to keep U.S. forces operational in any environmental extreme.

Experiments with the reactor initiated the first formal neutron activation analysis program by the U.S. Army Medical Service for evaluation of sub-microgram quantities of biological specimens subjected to precisely controlled neutron bombardment. The process permitted simulation of radiation effects and accurate measurements of results.

The solution-type reactor was fueled by enriched uranium in seven gallons of Uranyl Sulphate solution. Being a self-contained closed unit, it emitted no harmful particles, fumes or smoke into the air or public disposal systems.

Utilization of the reactor, made available also to other U.S. governmental agencies, included attempts to explore life processes in animal tissue and cell structures when subjected to nuclear radiation. This led to radioactivation analysis techniques for determination of trace elements in biological samples. Studies for the development of diagnostic and treatment methods were also conducted.

WRAIR researchers turned to investigation of gamma ray neutron injury mechanisms. Gamma rays destroy living cells just as X-rays do and neutrons are subatomic particles produced in large amounts from a nuclear reactor or nuclear explosion.

Investigations into fundamental life processes were made possible by the creation of radioisotopes—particles made radioactive through contact with neutrons.

Notable also among achievements during

the 9-year operation of the reactor was initiation of the first Army use of Florine 18 for bone scanning, a test utilized in detection of possible bone cancer.

Billy G. Bass, former director of the reactor facility, stressed the mission the reactor successfully performed in research and production of radioactive pharmaceuticals for clinical applications. Much of the information gained on radiation injury mechanisms, he said, hopefully will be analyzed to find eventual applications.

Operating costs of the facility were termed minimal by Bass. He said difficulty in obtaining trained personnel to conduct experiments, radiation technological advances at other sites, and more pressing research programs at WRAIR, requiring additional laboratory space, contributed to the phase-out of the reactor.

Research facilities at the National Bureau of Standards and the Diamond Ordnance Radiation Facility will be used to conduct future radiation studies.

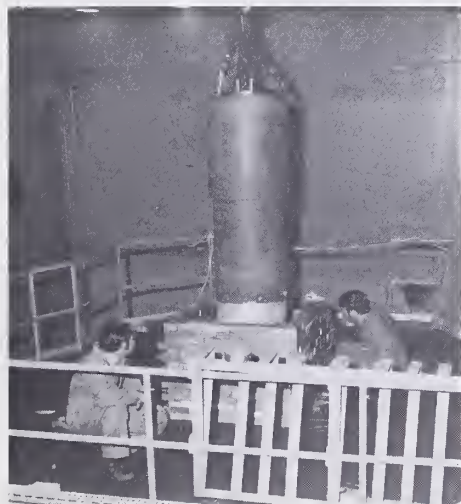
The WRAIR facility, considered unique in its dedication, was also unique at its closing. It was the first non-Atomic Energy Commission nuclear reactor to be completely dismantled.

When it was defueled at the beginning of August 1971 by a New York contractor, the fuel was shipped to the AEC for storage. The protective biological shield surrounding the core of the reactor was completely demolished late in December. Unique to the demolition process was development of a vacuum system for the collection and disposal of possible radioactive particles.

Much of the reactor's ancillary equipment is being utilized for recording purposes with other WRAIR medical instrumentation systems. However, the most long-term beneficial trace of the reactor's relatively short life cycle is expected to be the expansion of medical knowledge of radiation effects on living tissues that will be applied by the Army scientific and medical community in the years to come.



INITIAL STAGES of Demolition of Protective Biological Shield



REMOVING Core of Nuclear Reactor
MARCH-APRIL 1972



FINAL STAGES of Demolition of Protective Biological Shield

Sentinel System Advanced Computer

Army Ballistic Missile Defense Agency Announces Contract To Develop PEPE (Parallel Element Processing Ensemble)

PEPE, denoting Parallel Element Processing Ensemble as applied to data-processing techniques developed for United States advanced ballistic missile defense system, is progressing under a contract with the System Development Corp.

Awarded through the U.S. Army Ballistic Missile Defense Agency (ABMDA), in October 1971, the contract provides for advanced development of a new type of digital processor.

PEPE uses highly parallel, associative-processing techniques to augment the capabilities of conventional digital computers, typified by the huge third-generation International Business Machines 360/195 or the Control Data Corp. 7600.

Research and development activities are sponsored by the Office of the Chief of R&D, Department of the Army, and the project is termed one of the nation's most significant computer development projects.

PEPE's origin dates to 1964 when Bell Telephone Laboratories (BTL) scientists achieved a technological breakthrough in a new method for processing large amounts of data at high speed.

Conventional methods of increasing data-processing speed—that is, by increasing circuit speed, or by employing logic and architectural techniques to achieve some moderate degree of overlapped data access and instruction execution—were at that time approaching a practical limit.

Methods of increasing data-processing speed then were limited by one fact—data were still processed one, or at most a few, items at a time. Therefore, some method had to be found to process data in bulk, or in the aggregate, rather than one or a few items at a time. BTL scientists found the nucleus of a method in a concept they developed and called DLM-Distributed Logic in Memory.

DLM is a data-storage device, different from and much more powerful than those that most people are familiar with in contemporary computers. A DLM memory is comprised of a number of cells, each containing storage for one word of any arbitrary bit length.

Cells in DLM memory are accessed randomly, just as are words in a conventional core-storage memory. However, the cells are accessed associatively—that is, by content, rather than by location or

address, as is the case with words in a conventional core storage memory.

The location of a word in DLM storage is irrelevant. It is not necessary to know the location or content to access the word—merely an identifying feature contained in the word.

DLM memory cells also contain some logical manipulation capability; they can execute primitive, but powerful, instruction strings on data they have stored. This logical capability exists within the DLM memory itself—not in an external processor, as is the case with conventional computer architectures where memory is used for storage alone.

Most conventional data-processing machines access words in memory by location, that is, the machine must know the physical location, or address, of the word to find it. An instruction in a con-

ventional computer generally includes the address of the operand to be used in the instruction.

The operation specified in the instruction is performed on only one word in memory—the word found in the address specified in the location part of the instruction. This location addressing, which requires that we operate on only one word at a time, complicates a great many operations commonly encountered in data-processing-sorting.

For example, to find the largest word in a block of memory, it is necessary to access and test every word in the block, since there is not necessarily any correspondence between the size of a word and its location.

In the content-addressed memory, physical locations of words are irrelevant. Words are accessed by some attri-

APG Tests Microwave Oven Effects on Pacemakers

Microwave cooking ovens at Aberdeen Proving Ground (APG), Md., are undergoing regular tests to determine the effects radiation leakage from such ovens may have on individuals who wear cardiac pacemakers within close proximity.

Hidden hazards involved were first noted by the Office of the Surgeon General which last year became acutely interested in how microwaves from these ovens can adversely affect the functioning of the heart pacemaker.

Evaluation of the ovens has indicated that minor maintenance problems, if not corrected, could eventually cause microwave radiation leakage greater than 10 milliwatts per square centimeter.

A device known as the NARDA Microline Mini-Surveyor is being used for testing. Comparing in size to a transistor radio, this portable unit records radiation leakage through the use of a sensor-probe applied around the outer edges of the ovens. If the tests indicate a level of predetermined danger, the oven in question will be taken out of service.

The cooking process in ovens of this type is accomplished with microwave energy generated by a magnetron tube. This energy is the same type as that emitted by radar units and hazards involved are usually confined to the area surrounding the oven door.

Leakage from microwave ovens is usually caused by a worn door seal, faulty door safety interlocks, and on ovens with a viewing area by the seal around the faceplate or screen. Failure of door interlocks to shut off the oven when the door is opened could expose nearby personnel to microwave levels a hundred-fold above safe levels.

A survey team from the U.S. Army Environmental Hygiene Agency, requested by APG, found that using metal cooking containers or aluminum-foil wrapped foods in these ovens also increased leakage levels. The team recommended that microwave cooking ovens in post snack bars be subjected to regular tests for radiation leakage.

Their report showed ovens in good operating condition with low leakage levels do not present a hazard except to personnel wearing pacemakers.



USE OF NARDA Microline Mini-Surveyor, to test for radiation leakage on a microwave oven, is demonstrated by Joseph Sheckells of the APG Safety Office.

bute they contain, which explains the term content-addressing.

Generally, at least two instructions are needed to execute an operation on a word stored in content-addressed memory (CAM). First, some type of select instruction containing as an argument the attribute of the wanted word is executed.

As one example of a typical CAM attribute, a match between the left-most 10 bits of a word in memory, and the content of an external 10-bit match register might be required. The select instruction is executed simultaneously on all words. All operations requiring any type of memory search can be executed efficiently and rapidly.

Suppose there is a hall full of people and that the hall corresponds to a computer memory. The people correspond to the words in memory—one person, one word. Suppose the names of all people over 40 years old are wanted. If the memory is accessed the way a location-addressed memory is accessed, each person, one at a time, would be asked if he were over 40 years old.

When one answered "yes," then his name would be asked. This would take a long time, but that's the way a conventional location-addressed memory works. Now if the hall were a CAM, the simple question, "Will all persons who are over 40 years old please stand up," would be addressed simultaneously to everyone. Then the name of each standee would be asked.

Since this second method sounds so simple and obvious, it could be expected that it would be used more often in computers. The reason it has not been used more is that CAMs are much more complicated physically; they require much more hardware than location-addressed memories.

Only since the advent of integrated circuits have CAMs become at all practical. In the coming years, as the state-of-the-art in Large-Scale Integrated (LSI) circuits advances, more CAMs are expected to come into service.

In mid 1968, as the Bell people continued to work on the DLM concept and expanded it into PEPE, the Advanced Ballistic Missile Defense Agency saw considerable potential in concept for processing much greater amounts of radar data in the aggregate than could be processed sequentially.

ABMDA funded BTL to continue research but to direct it toward the radar data-processing problem in ballistic missile defense; also, to build a model which could be used to demonstrate the feasibility of PEPE in radar data-processing service. That model was built and the

feasibility demonstrated late in 1971. Known as the ICM (Integrated Circuit Model), it is fabricated from commercial off-the-shelf integrated circuit packages.

Since BTL felt that PEPE feasibility would be demonstrated by late 1971 and that their job would be finished when that feasibility was demonstrated, ABMDA invited a number of other companies to engage in a limited competition for future PEPE contract activity.

SDC was selected to continue PEPE development, first as a subcontractor to BTL, then in October 1971 as the prime contractor. SDC, in turn, selected Honeywell as subcontractor for PEPE hardware implementation studies for future PEPE models.

The computer subsystem in a ballistic missile defense system must contend with all sorts of threat components—reentry vehicles (RVs), decoys, jammers, chaff, and all kinds of threat debris. It must also coordinate information on interceptors, interceptor farms, nuclear fireballs, dust and debris caused by nuclear explosions.

The environment with all these objects is examined by sensors such as phased-array radars. Raw radar data, describing the environment, is transferred to the computer subsystem's dynamic environmental data base.

The raw data comprises such information as target positions and velocities, target radar cross sections, interceptor positions and velocities; also, such data on chaff clouds and nuclear fireballs as radars are able to gather.

All of this information is, of course, perturbed by many different types of noise, both natural and man-made. The dynamic environmental data base operates on the raw data to produce an edited, smooth, compressed and reduced description of the environment.

This is accomplished dynamically, in real time (measured in microseconds), so that at any instant the data base contains an up-to-date, smooth description of the *relevant* parts of the environment.

Performing the role of the dynamic environmental data base is the kind of mission for which PEPE is designed.

The Command and Control Computer (CCC) which PEPE would be augmenting would perform the remainder of the data-processing required in a Ballistic Missile Defense System (BMDS). Based on the smoothed environment description it obtains from the dynamic environmental data base, the CCC would issue orders to interceptors and to the radar, generate display data, and communicate and provide coordination with

other ballistic missile defense systems and centers.

As has been indicated, a large part of the Ballistic Missile Defense (BMD) problem is involved with the maintenance of the environmental data base. The magnitude of this part of the problem is enormous, and it is sensitive to the threat. The larger the threat, the bigger the data base, and the more difficult it is to maintain.

Maintenance of the data base for ballistic missile defense has one unique feature. Comprising essentially identical mathematical operations executed on many different pieces of data, it is the kind of problem PEPE—with its highly parallel structure and its associative file-processing features—was designed to solve.

ABMDA officials say PEPE can handle the problem with great efficiency, regardless of its size, making maintenance of the data base essentially independent of the size of the threat. Thus, the host computer to which PEPE would be attached would be free to handle the highly sophisticated operations which are sequential in nature.

PEPE is comprised of three major components—the Host Computer, the Control Unit, and a set of Elements. The combination of Control Unit and all of the Elements is called an Ensemble.

PEPE Elements are identical in that each contains a Correlation Unit, a Memory, and an Arithmetic Unit. An Ensemble can have any arbitrary number of Elements; a practical range is from about 50 to more than a thousand.

In ballistic missile defense each Element might have assigned one of the targets under observation by a radar. In this case, there would be at least as many Elements as expected targets. All the data on a target are stored in its assigned element, and all the operations on that data are performed in that Element.

PEPE processes the target data in parallel—it assigns an Element to each target, and since Elements execute instructions simultaneously and in parallel, the target data are processed simultaneously in parallel. This happens no matter how many targets exist, so long as there is at least as many Elements as targets.

A melding of the hardware and software design requirements to insure total system efficiency has been a characteristic of PEPE development. During the development of ABMDA's advanced version of PEPE, trade-offs based on past experience, the advancing state-of-the-art, and possible future threats will be performed to continue accenting total system efficiency.

Trio Develops Blood Cholinesterase Measuring System

Automatic, accurate measuring of blood cholinesterase activity is being accomplished with a new method developed by a trio of scientists at the Biomedical Laboratory, Edgewood Arsenal, Md.

The team includes Dr. Robert I. Ellin, chief of the Clinical Laboratory Section, William A. Groff, a research chemist, and Andris Kaminskis, a research biologist.

"The technique is not only precise," Dr. Ellin said, "but introduces a new dimension of validity to automated blood analysis systems. . . . Consequently, cholinesterase determinations can now be reliably compared between research laboratories throughout the country."

He explained that the system, designed primarily to provide a versatile and accurate automated method for measuring blood cholinesterase, also can serve to standardize experimental conditions for reporting enzyme activity.

The system can evaluate between 30 to 60 blood samples an hour with an autoanalyzer, a clinical chemistry instrument that measures cholinesterase in plasma, red blood cells and whole blood.

Since the system can be used with an automatic or manual dilution, either venous or capillary cholinesterase blood samples can be evaluated and reproduced. The two methods of dilution can be used interchangeably since no significant differences were noted in the activity values obtained by the two techniques. Six hours of continuous testing over a wide range of dilutions revealed repeat values and precision at low levels of enzyme activity

were excellent.

Dr. Ellin, author of more than 40 technical publications, received a BA degree in science from Johns Hopkins University in 1946 and his doctorate in pharmaceutical chemistry from the University of Maryland's College of Pharmacy in 1950. He has been employed at the arsenal since 1956.

Kaminskis, a native of Latvia, received a BS degree in biology from Brooklyn (N.Y.) College in 1959. Employed at the arsenal

since 1966, he has authored eight technical papers.

The significant feature of the new system is its versatility, in his opinion, in that accurate blood cholinesterase measurements can help to determine the severity of certain insecticide exposures and can be used in diagnosing liver functions and recording a patient's response to anesthetics.

Groff earned a BA degree in biology from the University of Virginia in 1950 and has been conducting scientific research at Edgewood Arsenal since 1951. He has authored more than 30 technical publications.

IMPACT Seeks Better Materiel Acquisition Procedures

IMPACT (Improved Management of Procurement and Contracting Techniques) has been initiated by the Army Materiel Command (AMC) as a program to review the acquisition of major defense systems.

Consisting of a number of sub-programs, IMPACT will focus on improvement in the key aspects of weapons systems acquisition.

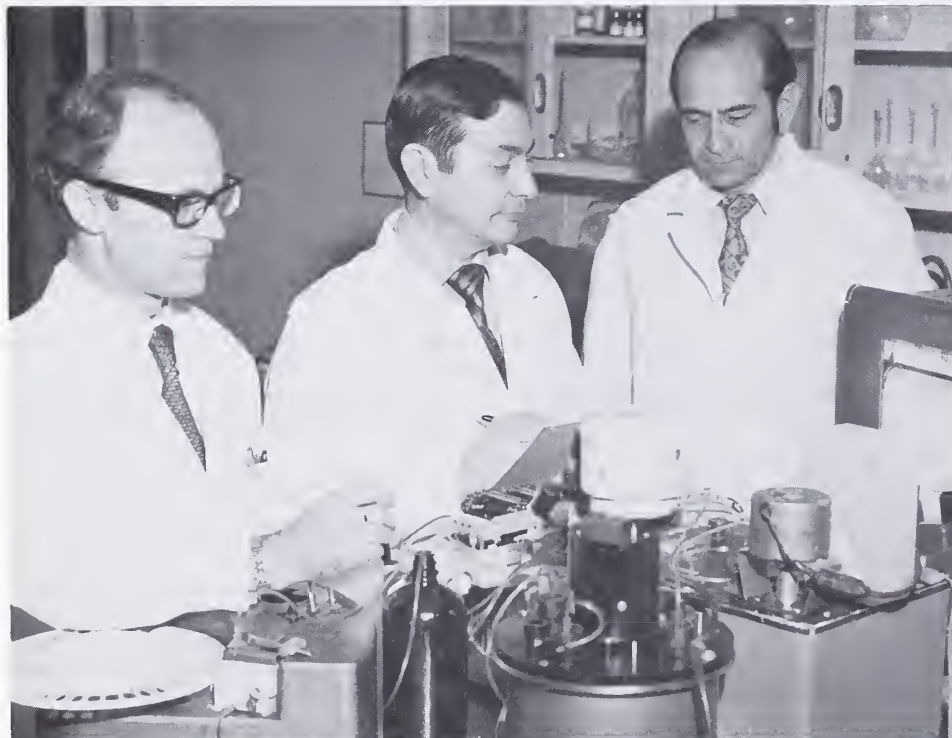
The program was created to bring about improved estimation of capabilities, tighter control over program changes, better assessments of program risks, greater use of competitive prototypes, and assurances of adequate developmental preparation before production of military materiel.

IMPACT is intended to be a long-term sustained program of improvements. It is the successor to another AMC study called "PROMAP" for Program for Refinement of Material Acquisition Process, which was a one-year plan that included 53 separate tasks.

In addition to risk and cost analysis, IMPACT tasks include the study of new concepts in materiel needs, the training of negotiators, the selecting and training of new project managers and the enhancement of the careers of military officers in procurement and research and development.

Reduction of costly data requirements procured from contractors will be another IMPACT job, as will be the study of criteria for cost and scheduling control systems.

AMC has named Samuel M. Lipnick coordinator for IMPACT. He is presently serving as chief of Edgewood Arsenal's Systems Concepts and Studies Division.



RESEARCH SCIENTISTS Dr. Robert I. Ellin (right), William A. Groff (center), and Andris Kaminskis check blood samples through a new method for automatically and accurately measuring blood cholinesterase they perfected at Edgewood Arsenal, Md.

Missile Command Initiates Nike Hercules Modification

Initiation of a major modification program on Nike Hercules which will enable the air defense system to meet more sophisticated threats during the 1970s was announced in February by HQ Army Missile Command, Redstone Arsenal, Ala.

Improvements will make the missile more maneuverable and better able to counter targets operating in an electronic countermeasures environment, it was stated.

Nike Hercules was deployed nearly 14 years ago but is still the United States' primary high-altitude air defense weapon.

Known as SAMCAP (Surface to Air Missile Capability), the modification program is being done initially by Western Electric Co., Nike Hercules prime contractor. Army depot teams will do follow-on installation to update old equipment. Modified hardware has been undergoing tests and evaluation at White Sands (N. Mex.) Missile Range.

The Nike Hercules system has proven effective against targets traveling at more than 2,100 miles per hour, at ranges greater than 75 miles and at altitudes in excess of 100,000 feet, with a capability of destroying an entire formation of hostile aircraft.

The program is under the Air Defense Special Items Management Office, headed by COL Morris W. Pettit.

AMC Night Vision Lab Develops Thermoviewer With Potential for Many Military, Civilian Uses

Development of a new Thermoviewer as one of the U.S. Army's growing family of devices to detect the enemy at night as well as during the day, announced in mid-January by the Army Materiel Command, is expected to yield many civilian applications.

The AMC Night Vision Laboratory, a Fort Belvoir, Va., element of the Electronics Command, Fort Monmouth, N.J., is credited with development of the Thermoviewer. Its potential for civilian applications has been demonstrated initially by successful use to detect loose rock that might cause mine cave-ins; also, to study earth surface temperatures in geological surveys.

Other potential uses of the hand-held device include detection and mapping of thermal pollution in water and a variety of medical applications, such as detecting cancerous tissue beneath the skin and studying burned tissue.

Unlike previous image intensification devices, such as the Starlight Scope, the Thermoviewer can work in absolute darkness.

Since it detects only differences in temperature, it can be used in either darkness or daylight to indicate a person or vehicle, partly shielded by foliage or camouflage. It also can be used to see through light fog or haze because it works at a larger wavelength than that of visible light.

All objects with temperatures above absolute zero emit thermal radiation, or heat. In the visible wavelength, these waves can be seen, for example, as flames or the glowing red of heated iron. In other wavelengths, a detector is necessary.

The Thermoviewer has a detector array of lead selenide, thermoelectrically cooled to almost 160° F. below zero. The array is scanned electronically to create an image on a phosphor screen visible through the eyepiece.

Weighing only six pounds, it can be handled as easily as a pair of binoculars. It is powered by a belt-mounted, 5-pound, 6-volt rechargeable battery pack capable of 12 hours of continuous operation.

The principle of operation is not new, but previous equipment was heavy, bulky, and took 20 minutes to create a visible image. The Thermoviewer requires no outside illumination whatsoever.

The U.S. Bureau of Mines, testing the device in conjunction with the Night Vision Laboratory, found that it detected hazardous loose rock behind apparently solid mine walls and in supporting pillars.

The bureau discovered that the temperature of the air space around concealed loose rock was affected to a greater degree by mine temperatures than the solid rock surrounding it — a heat difference easily spotted by the Thermoviewer.

Since rock falls in mines cause more than 100 fatal accidents in coal mining operations annually, the location of undetected weaknesses in apparently solid walls and pillars could save many lives.

The device also could be used to locate underground mine fires, combustion in waste dumps, and underground water courses.

The Remote Sensing Geophysics Group of the U.S. Geological Survey mounted the Thermoviewer in an aircraft for flights over the Survey's Oklahoma test site. It proved valuable in making a detailed study of conditions which affect surface temperatures of the earth.

Similarly, thermal pollution of lakes, rivers and streams could easily be seen through the Thermoviewer carried in an aircraft.

Suggested also is that the device might be a valuable aid in nighttime sea rescue work, since it could detect the difference between seawater temperature and that of anyone in the water, or in a boat. This would be similar to the military application of detecting swimming infiltrators attempting to approach friendly locations.

Creative concepts are expected to lead to numerous other innovative civilian applications for the Thermoviewer.



CIVILIAN APPLICATION of Thermoviewer includes detection of loose rock that might cause serious mine cave-ins.



MAN IN FOLIAGE as viewed by the human eye is shown in photo at left, and as viewed in the same surroundings, at right, without added light, through the Thermoviewer.



Thermoviewer (AN/PAS-7)



I am all in favor of a vigorously critical attitude towards technological innovation: we should scrutinize all attempts to improve our condition and make sure that they do not in reality do us harm; but there is all the difference in the world between informed and energetic criticism and a drooping despondency that offers no remedy for the abuses it bewails.—Sir Peter Medawar

Missile Target Seeker Probes Spectral Scanning

Study of conditions confronting missile guidance systems in delivering warheads against targets is one of the new research projects in exploratory development at the Army Missile Command (MICOM), Redstone Arsenal, Ala.

MICOM's Research, Development, Engineering and Missile Systems Laboratory (RDE&MSL) is collecting data on what a terrain-watching missile might "see" on the ground as it approaches a target.

A key to success in developing a missile guidance system is to make it sufficiently sensitive to conditions so it can identify and lock on the correct target. The Redeye, for example, uses an infrared seeker to identify a particular characteristic of its target, the heat of an aircraft engine.

To find out what a terrain-watching guidance system, using the electromagnetic spectrum (visible and invisible light), would be up against, scientists are employing an electronic pod with sensors mounted on the belly of a small aircraft, the VC-6A.

A slim cylinder with a transparent nose, the pod contains an experimental dual spectral-scanning radiometric measurement system. Two radiometers, mounted in the pod, have the same field of view and examine separate portions of the electromagnetic spectrum.

Findings are translated into electric impulses which make the appropriate marks on an analog tape recorder carried in the aircraft, thus preserving a record for analysis.

One of the radiometers records energy reflected from the ground in the visual spectrum, the other a narrow band in the infrared region. Simultaneously, a voice recording is made by an operator in the aircraft describing the terrain below.

Examination of the tapes later will give engineers a chance to learn more about natural objects and lighting conditions—for example, sunlight reflecting off a lake which might prevent a missile sensor from finding its true target.

The VC-6A will be used for other research and development missions. While it travels widely in accomplishment of these tasks, the

electronic pod will compile data that will assist in making comparison evaluations between visual and infrared radiations from such natural terrain features as forests, plowed fields, standing crops, lakes and rivers. Evaluations could also include low clouds, cities and towns.

The measurement system was developed by MICOM's Advanced Sensors Directorate. Aircraft modifications were worked out by the Ground Equipment and Materiel Directorate.

ARO-D Seeking to Improve Rocket Engines Stability

Improved control and stability in rocket engines may eventually be expected as a result of studies being carried out under the Army Research Office in Durham, N.C. (ARO-D).

Utilizing a new mathematical technique of matched inner and outer asymptotic expansions, the research is helping to unravel the complexities of rocket combustion and aircraft fires.

In analyzing the effect of coupling mass and momentum transfer with reaction kinetics, the theoretical investigation uses newly developed mathematical techniques to study combustion. The diffusion flame, burning droplets with free convection, and combustion above a semi-infinite plate are among the reactions studies.

Under contract, Dr. Francis E. Fendell of TRW, Inc., chief investigator, has applied asymptotic methods to a wide variety of problems, including free convection conditions such as fires or unconfined free burning as arise in aircraft crashes and incendiary bombing.

In the past, solutions to practical combustion and flow problems have relied heavily on full-scale testing. This slowed progress, but the complexity of some of these problems seemed to preclude their solution by using theory alone.

The current studies have recently led to reportedly important breakthroughs. Already, methods of predicting velocities of the firewhirls in napalm bombing and other destructive vortices such as tornadoes have been developed and verified through this mathematical technique.

Since 1965, Dr. Fendell has been applying the asymptotic methods to burning in initially unmixed reactants in both propulsion and conflagration problems.

Recent advances in mathematical analysis have also been applied to suggested simplifications in aerothermochemical formulation. Aerothermochemistry, still in its infancy, is a field christened with this name over a decade ago by Theodore von Karman. It implies the combined study of aerodynamics, heat transfer, and chemical reaction.

Empirical rules, applied in the past to the combustion theory, seem to have an alternative in high speed digital computers. Since numerical calculation is quite expensive for the solution of every combustion problem, mathematical analysis provides a simple, closed-form solution.

The method is also proving beneficial in resolving the nature of shear distribution near the leading edge of an airfoil. This phenomenon is important in understanding helicopter aerodynamics and in designing changes for improved performance. Applying the matched asymptotic

method to this flow condition, particularly near the airfoil stagnation point, has resulted in some interesting and significant insights.

The asymptotic method has already extended the understanding of a wide variety of combustion problems. It offers promise for major advancements in analyzing the burning of initially unmixed reactants.

Applications range from missile propulsion and re-entry to firestorm generation, improved control of free-burning fires and forest defoliation by aerosol spray.

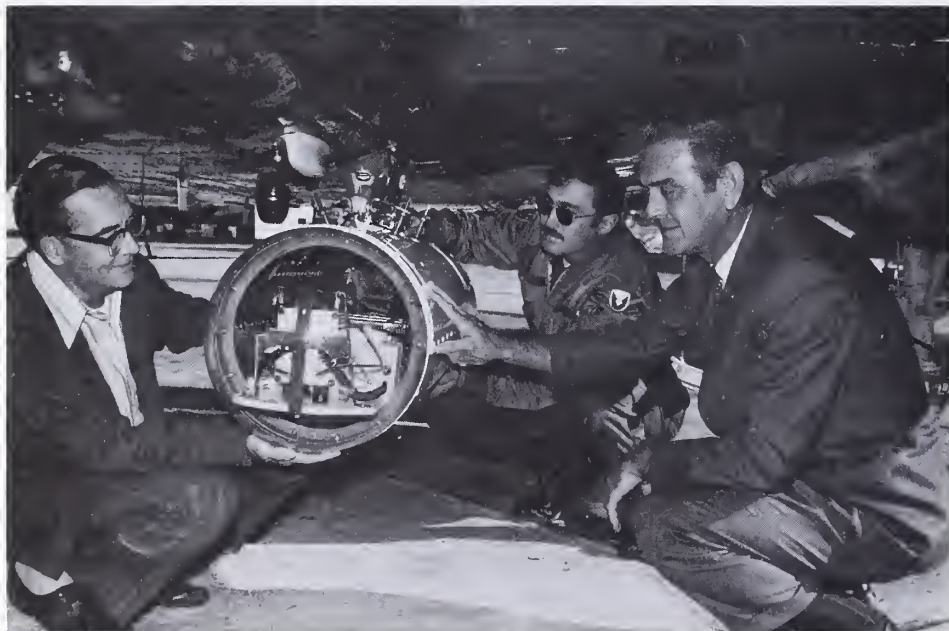
This fresh approach seems to have the potential of providing major advances in an extremely challenging aspect of engineering.

Picatinny VE Idea Saves \$290,000

Nearly 16,000 105mm HEAT-T cartridges, scheduled for conversion to inert training rounds because of suspected body cracks, were saved for use as high explosive rounds when a Picatinny Arsenal engineer's idea was adopted.

Henry Hartmann of the Product Assurance Directorate came up with the idea of using an extremely low-current crack detection device to see if the projectiles had invisible cracks.

The value engineered test showed most of the 16,400 cartridges were safe. Nearly \$290,000 was saved by eliminating the cost of converting the cartridges to training rounds and replacing them with new high-explosive shells.



ELECTRONIC POD, which collects data on conditions that might affect a missile in flight, is mounted on belly of small aircraft. Viewing the experimental instrumentation at Redstone Arsenal, Ala., are Van Swearingen (left) and William Baysinger (right), employed by the U.S. Army Missile Command's Advanced Sensors Directorate, and SP5 Eugene Taffera, assigned to navigation aids research at Redstone Army Airfield.

NBS Research Demonstrates Possibility of Standardized World of Time, Distance

National Bureau of Standards (NBS) scientists report they have achieved "prodigious accuracy" in measuring the "fourth dimension," that of time, in advanced frequency wave research at the NBS Laboratories, Boulder, Colo.

By measuring the frequency of an infrared laser beam, the wavelength of which was already known, the team of four scientists has laid the groundwork for linking international standards of time and distance.

NBS Director Dr. Lewis M. Branscomb, commented on this scientific "breakthrough": "Ever since Albert Einstein showed that time can be considered a fourth dimension of the space in which we live, scientists have looked forward to the possibility of using one gage, one yardstick so to speak, not only for the three dimensions of space, but for the fourth dimension of time, as well. . . . With this demonstration that both the space (wavelength) and time (frequency) dimensions of a single light source can be measured with prodigious accuracy, this goal is now within our grasp."

In the NBS experiment, scientists D. M. Evenson, J. S. Wells, G. W. Day and L. O.

Mullen found that the absolute frequency of the helium-neon laser is 88,376,245,000,000 Hertz (cycles per second) only a factor of five lower than visible light.

Prior to this measurement, frequencies this high had to be calculated by dividing the speed of light by the measured wavelength, but frequency measuring techniques are over 10,000 times more accurate than wavelength measuring techniques.

In the past, the most accurate speed of light measurement was made by measuring the wavelength and frequency of relatively low-frequency radio waves. The measurement of wavelength was limited at these low frequencies to an accuracy of some 300 parts per billion.

NBS researchers now say that at high frequencies the measurement of wavelength will be limited only by the accuracy of the length standard itself. This will result in a 30-fold increase in the accuracy of measurement of the speed of light.

In the new process, the helium-neon laser frequency (with a wavelength of 3.39 micrometers) is measured by using a specially constructed diode as a harmonic generator and

mixer. The diode multiplies accurately known lower frequencies, from other lasers and microwave generators, to obtain a signal approximately equal to the unknown frequency being measured.

The same diode then mixes in the unknown frequency and produces a signal equal to the difference between the known and the unknown frequencies. This low frequency difference, of a few million Hertz, is then measured using well established methods.

The diode which accomplishes this harmonic generation and mixing is a microscopic version of the catwhisker diode used in the early days of radio. Only one ten-thousandth of an inch in diameter, the sharpened tungsten wire whisker touches a nickel surface on the diode, and the wire itself serves as the antenna for the laser radiation.

Having a more accurate value for the speed of light will aid scientists in tracking satellites and space vehicles, and the astronomer in measuring interplanetary distances. The down-to-earth significance is that with this standard more clearly defined, manufacturers should achieve unprecedented accuracy in the production of instruments and other precision equipment.

Environmental scientists are expected to find that improved control of more precisely tuned lasers will permit new progress in the study of minute quantities of environmental pollutants.

RIA Develops Protective Container for 152mm Ammunition

Completion of the task of designing, developing and fabricating a moisture-proof container to protect 152mm ammunition, involving an advance in plastics technology, was announced recently by HQ U.S. Army Weapons Command, Rock Island, Ill.

WECOM assigned the task to its Rock Island Arsenal in February 1970. The RIA Research, Development and Engineering Directorate decided to use the skills of arsenal engineers and production craftsmen to expedite work.

This use of in-house design and production capabilities resulted in rapid response to the problem of fabrication difficulties that initially troubled private contractors.

Given an order in January 1971 for initial delivery in June, the first contractor needed the help of RIA personnel to use RIA-developed mold drawings. An acceptable

bag was not produced until October. A second contractor also required RIA technical assistance for jet-injection molding of the bags.

WECOM research resulted in an elastomeric (rubber) bag that reportedly meets all requirements for moisture-proof packaging of 152mm ammunition. As of mid-January 38,000 bags had been delivered.

RIA production workers are employed three shifts a day, six days a week to produce 6,000 bags a month, in addition to contract production. Fabrication of the bags to fill current orders is scheduled for completion and delivery by June.

WECOM contends that its success in solving a troublesome problem in plastics technology, on a rapid-response basis to an urgent requirement, points up the advantage of maintaining in-house production capabilities near its research laboratories.



MORE TRIMMING as William Hawkins (foreground) and Wilburn Meadows trim and talcum moisture-proof containers designed to protect 152mm ammunition.

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INSPECTING finished bag are Lee Watts and John Cerny Jr. who, along with Glenn Kessel, developed the container from concept to assembly-line production.

ARMTE Changes 2 Divisions To Improve Management

Realignment of two divisions within the Army Missile Test and Evaluation Directorate (ARMTE), a major element of White Sands (N. Mex.) Missile Range, has been announced by COL Joseph P. Pepe, director of ARMTE.

The Test Engineering Division and the Field Operations Division have been reorganized to form three: Air Defense Materiel Test Division, Land Combat Materiel Test Division, and Maintenance Evaluation Division.

Each of the materiel test divisions will consist of four branches while the Maintenance Evaluation Division will have two branches.

These changes are designed to provide improved management and control of missile project operations, through better delineation of both levels and types of work. Greater emphasis is also placed on maintenance evaluation by elevating this function to the division level.

Metzger Assumes CSC Duties With Tactical Systems Office

Leadership of the Project Control and Integration Directorate, Office of the Deputy for Tactical Systems, HQ U.S. Army Computer Systems Command, has been assumed by COL Edward H. Metzger Jr.

He recently completed his second tour of duty in Vietnam as chief, Personnel Advisory Division, Office of the Assistant Chief of Staff, HQ Military Assistance Command. He has also had an overseas tour as attache, U.S. Embassy in Warsaw, Poland.

ARO-D Announces Highlights of Annual Operations Research Symposium

Participants in the Eleventh Annual U.S. Army Operations Research Symposium, May 16-18 at Durham, N.C., will hear a keynote address by LTG Robert R. Williams, Assistant Chief of Staff for Force Development.

Sponsored by the Army Chief of Research and Development, through the U.S. Army Research Office, Durham (ARO-D), the symposium is expected to attract more than 200 operations research scientists representative of the Department of Defense, industrial organizations and academic institutions.

Two senior analysts of Stanford Research Institute (identity unannounced at press time) will follow the keynote address with a presentation on "Decision Analysis." Dr. Ralph Swalm of Syracuse University will open the afternoon session with a discussion on "Insights into Risk Taking."

Eight concurrent workshop sessions will complete the first-day program as follows: An Introduction and Demonstration of the Delphi Technique, Dr. Norman Dalkey, Rand Corp., Santa Monica, Calif.; Adversary/Advocacy, LTC Vernon Speicher, HQ Army

Materiel Command; The Bayesian Approach, Dr. Stanley Buchin, Applied Decision Systems Corp., Wellesley Hills, Mass.; and

Extrasensory Perception in Decision Making, Dr. James B. Rhine, Institute for Parapsychology, Durham, N.C.; Plotting Your Risk Profile, Dr. Ralph O. Swalm, Syracuse University; Reducing Risk Through Prototypes, Dr. Deiter Schwebs, consultant, Arlington, Va., and COL Robert Lochery, U.S. Air Force Academy; The Economics of Uncertainty, Dr. Edward B. Berman, Mitre Corp., Bedford, Mass., and Edward Winchester, Office of the Secretary of Defense, Washington, D.C.

The morning session of May 17 will be devoted to a continuation of the presentation of Decision Analysis by the Stanford Research Institute.

Topics and speakers programed for the afternoon session are: Theory of Ideal Weights in Weapons Evaluations, David R. Howes, U.S. Army Strategy and Tactics Analysis Group, Bethesda, Md., and Dr. Robert M. Thrall, Rice University; A New Formulation of the Lanchester Combat Theory, Dr. Frank

E. Grubbs, U.S. Army Aberdeen (Md.) R&D Center; The Thor Index of Combat Effectiveness, Dr. Robert M. Thrall and Dr. J. R. Thompson, Rice University; and

Decision Analysis for R&D, Dr. John D. Hwang, U.S. Army Air Mobility R&D Center, Ames Research Center, Moffet Field, Calif., and Dr. C. Richard Shumway, N.C. State University; Risk Analysis in Military R&D Projects, MAJ A. K. Varnell, CAPT J. McGrath, D. Salvano and W. Holmes, U.S. Army Electronics Command; VERT-A Tool to Assess Risk, Gerald Moeller, U.S. Army Management Engineering Training Agency, Rock Island, Ill.

Dr. Desmond C. O'Connor will chair a panel discussion on Environmental Risks in Army Operations. He is chief of the Environmental Sciences Division, U.S. Army Research Office, Office of the Chief of R&D, Washington, D.C.

A second panel session on Analysis on the Infrared Night Observation Device Long Range (NODLR) will be conducted by a team (unannounced at press time) from the U.S. Army Electronics Command Night Vision Lab, Fort Belvoir, Va.

Methods for Evaluating the Effects of Expanded Ballistic Missile Threats on Defense Deployment is the subject of Dr. William J. Douglas and Mrs. Mathilda B. Sutow, Keystone Computer Assoc., Inc., Fort Washington, Pa. Dr. Edward N. Dodson, General Research Corp., Santa Barbara, Calif., is programed for a presentation on Risk Analysis in acquisition of BMD Systems.

Other presentations include: The Value of a Soldier's Life Treated as a Problem in Risk Analysis, CAPT Daniel Newlon, Office of the Chief of Staff, Department of the Army; Risk Analysis in Weapons Development, Dr. Donald W. Hurta and Robert C. Banash, Army Weapons Command, Rock Island, Ill.; and A System of Near Real Time 'Casualty' Assessment in Field Experimentation, Walter W. Hollis, U.S. Army Combat Developments Experimentation Command, Fort Ord, Calif.

The banquet address will be given by BG Robert G. Gard Jr., Director of Discipline and Drug Policies, Office of the Deputy Chief of Staff for Personnel, Department of the Army.

Communications Horizons Discussed At Technical Society Symposium

"Expanding Horizons for the Communicator" was the theme of a Mar. 24 symposium of the New York and Philadelphia Chapters of the Society of Technical Communicators at Fort Monmouth, N.J.

BG Albert B. Crawford, project manager for Army Tactical Data Systems was the keynote speaker.

Projected military data requirements during the 1970s were stressed at the opening session, including skill analyses, training plans and programs, lesson plans and scripts, and equipment publications. Opportunities in audio-visual communication, training films, and allied products also were discussed.

Second-session subjects included phototypesetting, automated drafting machines, and computerized text processing. The third session was devoted to a survey of costing and pricing techniques.

Watervliet Improves Ultrasonic Testing of Gun Tubes

Life expectancy of gun tubes can be determined more accurately by use of an improved ultrasonic testing technique developed by Watervliet (N.Y.) Arsenal to gauge reliably the precise size and shapes of flaws and their manner of growth.

Ultrasonic (high-frequency sound wave) testing of cannon and weapons metal components has been in development for about a decade. It was reported as highly successful in detecting flaws as early as in 1964, when the *Army Research and Development Newsmagazine* October edition reported upon the technique.

The recently reported improved technique was developed in the arsenal's Materials Engineering Branch, headed by Dr. Thomas E. Davidson, to meet requirements imposed by cannon technological advances. These include higher operating pressures during firing, lighter weight and the use of higher-strength steel alloys in the manufacture of tubes.

Prior to ultrasonic testing, tubes could be examined only by visual or magnetic particle inspection. Early ultrasonic testing technology, as reported in 1964, permitted the detection of flaws but not the precise determination of the size, shape and manner of growth.

Used in conjunction with laboratory fatigue testing, the improved ultrasonic technique can eliminate the need for much of the field test firing formerly required, in the opinion of Watervliet researchers. Appreciable savings in time and money can thus be achieved.

Members of the team credited with developing the improved technique include metallurgist James Miller as leader in conjunction with electrical engineering technician Thomas Muckle, electronic engineer Donald Winters, and technicians Abraham Rubin and John Zalinka.



ELECTRONIC ENGINEER Donald Winters adjusts console as Robert Fuczak applies a crystal that will transmit high-frequency sound waves through an 8-inch howitzer tube.

OCRD Time-Phased Realignment Responds to Memo

Criteria established by an Army Chief of Staff memorandum and personnel reductions account for a time-phased reorganization within the Office of the Chief of Research and Development scheduled for completion by June 30.

Although the number of personnel involved is minimal, the organizational structure of OCRD will take on a new look.

Guidelines are: branches will consist of 7 or more persons and unstructured divisions will have 20; structured divisions made up of at least 3 branches must have a minimum of 23 persons; directorates will be comprised of 4 divisions, with a minimum of 80 military and civilian personnel.

This formula is predicated on the Chief of Staff's stated objective of eliminating intermediate levels of supervision to facilitate job enrichment while broadening the scope of responsibilities at all staff levels.

The staff reduction is minimal and involves principally military personnel. Agency reductions are, in most cases, equal to or less than the number of positions which do not meet the Chief of Staff criteria. Generally, the realignment requires conversion of some other military positions to civilian status to achieve the over-all reduction.

The Chief of Staff memorandum specified that agencies will 1) accomplish essential functions, 2) curtail questionable positions, and 3) enrich positions and broaden responsibility.

The OCRD realignment will consolidate the Directorate of Developments and the Directorate of Missile and Space in the Directorate of Developments.

The Research Technology Division, Studies and Analyses Division and Laboratory Review Office will be consolidated and called the Research Technology Division.

Consolidation of the Nuclear, Chemical and Biological Division and the Air Defense and Missiles Division will create the Missiles and Special Weapons Division.

Similarly, the Communications and Electronics Division and the Surveillance, Target Acquisition and Night Observation Division will be merged in the Command Systems Division.

Avionics functions will be centralized in the Air Mobility Division.

The Management and Evaluation Division will be redesignated as the Management and Test Division. Responsibility for supervision of the National Missile Ranges at Kwajalein in the Pacific and at White Sands, N. Mex., will be transferred to the new MTD from the Directorate of Advanced Ballistic Missile Defense.

Reorganization of the U.S. Army Research and Development Information Systems (ARDIS) Office will result in discontinuation of the Information Systems Office.

The U.S. Army Advanced Ballistic Missile Defense Agency will be reorganized. The details were unannounced at press time.

Personnel and functions of the Operations Office will be transferred to the Management and test Division and the Operations Office discontinued.

The Director of Developments Combat Materiel Division will assume monitorship of the U.S. Army Land Warfare Laboratory from the Surveillance, Target Acquisition, Night Observation Division.

The new Missiles and Special Weapons Division will be responsible for the functional areas of air defense systems, missile systems, chemical and nuclear weapons, nuclear weapons effects, chemical, biological and nuclear defensive techniques.

While the Management and Evaluation Division is being changed to the Management and Test Division to bring more visibility to OCRD's testing function, the other three divi-

sions of the Directorate of Plans and Programs will retain their same designations.

However, the functional statement of the Plans Division is being expanded to include program review and analysis (less cost analysis) and net technical assessment. No other functional changes are planned for this directorate.

The OCRD reorganization will make available a certain number of manpower spaces to be applied to priority requirements. As is the case with other Army staff agencies, the reorganization is expected to consider long-term objectives by taking into account a consolidation of similar functions.

As suggested by the Army Chief of Staff, the changes will allow people to begin adjusting to the new operational environment in preparation for planned FY73 changes.

New Test Stand Speeds Production at Watervliet

Engineers, technicians and craftsmen at Watervliet (N.Y.) Arsenal have designed, built and assembled sophisticated test equipment to meet stringent production schedules on a \$3.2 million order.

The U.S. Army Mobility Command order for complex components of combat assault vehicles imposed extremely rigorous quality assurance requirements. Employees in the Special Projects Division at Watervliet—usually concerned with weapons components design—designed two complicated hydro-electric-mechanical test stands.

Translated into hardware and assembled by millwrights, electricians and welders of the Maintenance Branch, the stands will help to fill the order well in advance of the contract deadline.

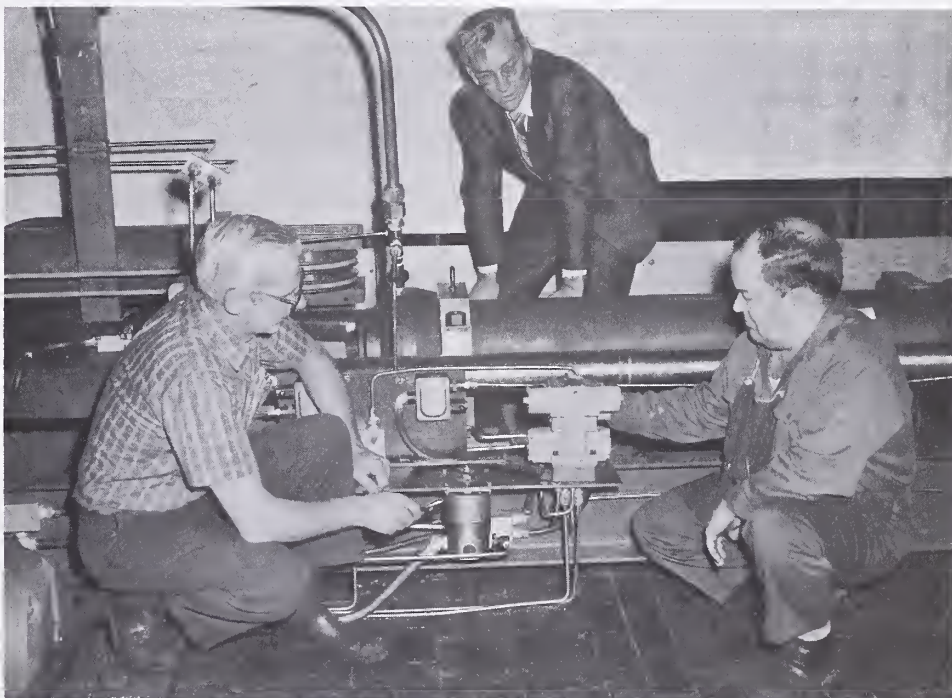
The job involves fabrication of major elements of a marine assault bridge-ferry used to

transport troops and equipment across water obstacles. The unit also can be used for multiple river crossings by armor and supporting elements.

Components tested on the stands will include 184 marine drive assemblies and 124 large hydraulic cylinders which raise and lower the bridge section.

Project manager Thomas J. Alaxanian cited the accomplishment as "particularly noteworthy" in view of the unusual nature of the job, the extremely demanding test requirements and the limited time element.

Walter H. Austin is chief of the Special Projects Division and Robert Thierry was project leader for the design effort. Alfred Zanotta headed the unit which built and assembled the test stands. Robert P. Bulger has production planning responsibility for the entire project.



INSPECTING TEST STAND, designed and built at Watervliet Arsenal to test a hydraulic cylinder which positions a section of a combat assault vehicle, are three of the men responsible for the project. From left, they are lead millwright James Kroup, special projects division chief Walter H. Austin Jr., and millwright Gerald Knapp.

Defense Reports Analyze Security Threat, U.S. Capabilities

Three Department of Defense presentations to the Senate Armed Services Committee, published for release Feb. 16-17, summarize evaluations of U.S. defense forces and plans to meet the challenge of the potential enemy.

Having in common an analysis of the mounting threat to U.S. overall superiority in advanced weapons systems, with emphasis on acceleration toward the objective of the potential enemy to achieve technological leadership within the next few years, the documents are:

- Secretary of Defense Melvin R. Laird's annual Defense Department Report for FY 1973, "National Security Strategy of Realistic Deterrence."

- Chairman of the Joint Chiefs of Staff Admiral Thomas H. Moorer's "United States Military Posture for FY 1973."

- Dr. John S. Foster Jr.'s "Statement by the Director of Defense Research and Engineering on the Fiscal Year 1973 Defense Research, Development, Test and Evaluation Programs."

After commenting in his introductory summary on some of the objectives of realistic deterrence detailed as goals in his FY 1970 and 1971 reports, Secretary Laird states:

"This 1972 report takes us another step forward. It completes the transition to a fully

developed National Security Strategy of Realistic Deterrence that complements and supports the President's Strategy for Peace."

War expenditures are "down by about two-thirds. American air activity in Southeast Asia has been reduced by well over 50 percent. Manifestly, U.S. involvement in the war is coming to an end."

Secretary Laird said authorized military strength in Vietnam in 1969 was 549,500 and by May 1, 1972, will be reduced to 69,000, pointing to the success of the Vietnamization program.

An urgent need now, he added, is to assure U.S. technological and weaponry superiority. "It cannot be said too often that an open society such as ours is at a disadvantage in facing the challenge of a closed society which seeks, through all means at its disposal, to become the world's greatest power."

"So I would repeat what I have said so many times: The American people may perhaps be willing to accept parity in regard to the deployment of strategic nuclear weapons; but, in my view, they will never accept a position of inferiority."

"Therefore, in order to avoid that unacceptable danger, it is absolutely essential that we maintain technological superiority. The

one billion dollar increase in the FY 1973 R&D budget over that which Congress gave us last year is aimed at maintaining superiority."

"The Soviet Union continues to expand its weapons development and deployment programs. There may be some debate as to whether—or by how much—the Soviet Union is outpacing us in research and development."

"What must concern any one responsible for our national security is the demonstrable fact that we could lose the technological race. And second place in that technological race is simply not good enough. . . ."

The FY 73 budget proposes "significant increases" for, among other things:

"Research and development, with emphasis on diversification, hardware development (including prototyping), basic research and exploratory development, and operational test and evaluation, to maintain technological superiority (and) improving General Purpose Deterrent Forces through weapons modernization."

In commenting on Department of Defense activities to "improve the quality of life for all Americans," he said thousands of physicians, dentists and medical personnel will be returned to civilian life in FY 1973. New research programs will be initiated to assist in the President's program to combat Sickle-Cell Anemia.

"Project MAST (Medical Assistance to Safety in Traffic) will also be expanded this year. This program supplies medical helicopters, many of them from Vietnam, to assist local communities in providing rapid care to accident victims." (This project had its origin in the phenomenal success of highly trained Army medical evacuation teams in Vietnam.)

The FY 1973 budget proposal of \$83.4 for defense includes "some \$28 billion for weapons investment." Basic parameters of Defense Department planning are directed to "four categories of potential conflict: Strategic Nuclear, Theater Nuclear, Theater Conventional, and Subtheater." The process is that of *Total Force Planning*.

What is new in Defense planning, Secretary Laird said, "is the enormous complexity that has entered into force planning since World War II, compounded by dramatic technological advances, major world economic adjustments, and a fragmenting of the past bi-polar world structure."

"The international environment is dynamic, confusing and in some respects disconcerting. This rate of change—political, economic, social and technical—is perhaps the greatest we have ever known. Net Assessment offers a valuable tool for understanding and responding to these challenges."

"... It is important to re-emphasize that any realistic assessments and resulting plans for military forces and new weapons systems must include political, economic and social considerations."

"Net Assessment plays a critical role in our Total Force Planning and in the development of forces necessary to maintain our national security. In these assessments we weigh the capabilities of potential enemies against our capabilities and those of our Allies."

"At the same time, we must give careful

Rush Sworn In as Deputy Secretary of Defense

Deputy Secretary of Defense Kenneth Rush succeeded David Packard in that office Feb. 23 when Secretary of Defense Melvin R. Laird officiated at the oath-of-office ceremonies.

Prior to accepting an appointment as U.S. Ambassador to West Germany in 1969, a position he vacated to assume his new duties, Rush gained industrial experience with Union Carbide Corp. Starting his climb up the executive ladder in 1937 as vice president, he became president in 1966.

President Nixon, whose association with Rush began as a law student in his class when Rush was an assistant professor at Duke University in 1936-37, nominated him for the No. 2 defense position Jan. 25. The Senate confirmed the appointment Feb. 3.

While serving as ambassador, Rush achieved international recognition during 17 months of negotiation climaxed successfully by the mid-1971 accord reached with the Soviet Union, Britain and France on access rights to the divided city of Berlin.

That accomplishment earned President Nixon's commendation for "dedicated and competent work" in resolving a highly controversial issue dating to the World War II terms on Berlin.

Born in Walla Walla, Wash., in 1910, Secretary Rush graduated from the University of Tennessee with an AB degree in 1930 and from Yale University Law School with an LLB degree in 1932. In

1961 he was awarded an honorary LLD from Tusculum College, Tenn.

Under former President Johnson he served on the U.S. Trade Policy Committee. He has also served as a member of the Council on Foreign Relations (chairman of the Industry Committee on Development), and as chairman of the board of the Manufacturing Chemists Association.

David Packard resigned as Deputy Secretary of Defense after serving more than three years to return to his duties with Packard-Bell Corp., which gained him distinction as one of the nation's top industrialists.



Kenneth Rush
Deputy Secretary of Defense

consideration not only to the strengths of potential adversaries, but also to the deficiencies in their capabilities and the various constraints with which they must cope."

The Soviet threat has been brought into sharper focus during the past year, Laird said, by developments such as:

- The Y-class ballistic missile submarine force of the Soviet Union could be as large as our POLARIS/POSEIDON force by the end of next year, rather than in 1974 as I predicted last year.

- The new Soviet supersonic dash bomber, the BACKFIRE, could be operational by the mid-1970s.

- Nearly 100 new ICBM silo sites have been identified for new or modified ICBM systems. The possibility of such a new deployment program was mentioned in my Defense Report last year.

- Construction of the Moscow ABM system has resumed, and testing of an improved missile continues.

- Ongoing Soviet naval ship construction programs include production of nuclear-powered torpedo attacks and cruise-missile submarines, and at least one large new cruiser, armed with multiple missile systems.

- New Soviet fighter aircraft, especially the high speed FOXBAT as well as the FLOGGER and FITTER B, are entering into the inventory.

- Two new Soviet tanks, one a light tank and the other a new main battle tank, are probably in production.

In elaborating further on the threat of the Soviets in efforts to attain technological superiority, Laird said:

"Since the late 1960s Soviet expenditures for technological development have increased at an average annual rate of more than 10 percent. For 1972, as an example, the announced science budget of 14.4 billion rubles is almost nine percent greater than in 1971.

"A major portion of these science expenditures are believed earmarked for RDT&E and space exploration. Any substantial increase in science outlays would therefore include an increase in these military related technological efforts."

While responsiveness of U.S. Armed Forces to the Soviet threat "cannot guarantee that technological surprises and problems will not develop," Laird said that "to the extent possible, we are incorporating flexibility in our own programs to hedge against increased threats or unexpected failures in U.S. systems.

"We also believe that our technology programs should result in diversified U.S. military systems, so that one adverse event is not likely to impact heavily on the U.S. deterrent posture. . . ."

Relative to U.S. development of the Safeguard ABM System, Laird said "technical effort . . . has progressed very satisfactorily and there are no technical problems which would affect a decision to continue a Safeguard deployment in FY 1973. . . . Of the seven tests conducted . . . all have been successful."

Turning to the topic of Modernization of Our Ground Forces, Laird listed among "major elements" such U.S. Army activities as:

New Main Battle Tank Program. In place of the MBT-70 program, terminated last year, the Army has initiated a new tank development program with the immediate goal of defining design and performance characteris-

tics. This is planned to enable the Army to field a tank capable of meeting the Main Battle Tank mission within the guidelines established by Congress.

M60 Tank. Improvements will be made on the M60 series tanks to provide better performance and longer life.

Advanced Attack Helicopter. In tests of the Cheyenne helicopter during the past year, the aircraft has met most of the desired requirements of performance and the weapon subsystem has exceeded the Army's expectations. Further testing is scheduled in FY 1973, the results of which will provide the basis for a decision to proceed further in FY 1974.

Heavy Lift Helicopter. The FY 1973 Budget includes \$53 million for continued development. Funds are provided for initial development of a single prototype.

Utility Tactical Transport Aircraft System. The Army has entered the contract definition phase of development on a helicopter to replace the UH-1H in the air assault role in the 1980s. This will be the Army's first true squad assault helicopter. The FY 1973 Budget includes \$64 million for this program.

SAM-D. Planned to replace Nike Hercules and Hawk, the SAM-D system has been allocated \$171 million in the FY 1973 Budget for engineering development. It is being designed to maintain its effectiveness in an intense electronic countermeasure environment.

Lance. Continued procurement of the Lance missile system is planned for FY 1973 and \$95 million is included for this purpose. This system will replace the aging Honest John and Sergeant systems.

U.S. Military Posture

In his annual report as Chairman of the Joint Chiefs of Staff, Admiral Thomas H. Moorer, USN, presented to the Senate Armed Services Committee an analysis of the military posture of the United States in relation to the "challenges which may confront our Nation during the next five or six years."

The report states that ". . . the Soviets are slowly coming abreast of us in relation to our tactical air forces and are continuing to widen the gap in relation to our ground combat forces . . . in view of the rapid growth in the sophistication of the Soviet attack submarine fleet, I must conclude that the U.S. Navy is no longer the unchallenged master of the seas. . . ."

Admiral Moorer said the large-scale naval shipbuilding programs now under way in the Soviet Union put the U.S. in a position of being "hard-pressed to maintain an appropriate balance in over-all naval offensive and defensive power in the years ahead. . . ."

In elaborating on details of many weapons systems comparisons made by Secretary of Defense Laird, Admiral Moorer discussed at length the evolution of U.S. and Soviet missile forces, including intercontinental ballistic missiles and MIRVs (Multiple Interceptor Reentry Vehicles).

Comparisons also are made in the report of U.S. and Soviet strategic bomber forces, strategic offensive and defensive balances, general purpose forces, theater nuclear forces, naval forces, tactical air forces, and ground combat forces.

Admiral Moorer concludes by stating: ". . . The military programs recommended in President Nixon's FY 1973 Budget represent the very minimum effort this nation should

be willing to support at this juncture. We must maintain our strategic deterrent, not only with respect to the Soviet Union, but also with respect to the Peoples Republic of China. . . ."

Dr. Foster's Report to Senate

Director of Defense Research and Engineering Dr. John S. Foster Jr. devoted the first 10 pages of his report to the Senate Armed Services Committee to generalities about the RDT&E budget proposal and a review of significant progress during 1971. Then he stated:

"Mr. Chairman, I must stress this point. We are not comparing ourselves with the Soviet Union strictly on a budget-to-budget basis in the hopes of wringing larger budgets from the Congress. We are comparing ourselves with the Soviet Union because a comparison of today's RDT&E programs in type, scope and level provides one of the major indicators of possible future challenges to our security. . . ."

"The sincerity of the U.S.S.R.'s commitment to the goal of technical military superiority is evidenced by the manpower, facilities and material resources it has allocated to produce the modern weapon systems that it has developed and deployed in large numbers.

". . . The Soviets have taken notice of past U.S. reductions in RDT&E expenditures, but their public statements and new five-year plan describe a continuing and systematic increase in their own efforts. The Soviets are openly demanding of themselves a more efficient, productive RDT&E effort with more 'output per ruble.' We remain convinced that our current U.S. technological superiority is in jeopardy. . . ."

In what he termed *not a net technical assessment* of combat capabilities but a "far simpler and more primitive technical comparison of present deployed U.S. and Soviet systems side-by-side, not face-to-face," Dr. Foster said:

"We would currently credit *Soviet-deployed* forces with *technological superiority* in: anti-ballistic missile systems; fractional-orbit ballistic missiles; strategic air-defense interceptors; all aspects of civil and industrial strategic defense and recuperative planning; tactical antiship missiles; surface attack ships (without carriers); antiaircraft artillery systems; some armored combat vehicles; medium- and high-altitude SAM air defenses; surface-to-surface tactical missiles, and heavy-lift helicopters.

"We would currently acknowledge *approximate technological parity* with the Soviets in deployed systems such as tanks and antitank weapons, satellite tracking systems, satellite navigation systems and small arms.

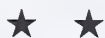
"But we believe we still retain our *technological lead* in *deployed systems* in ICBM guidance and penetration aids; strategic bombers; strategic submarines and SLBMs; attack submarines; ASW sensors and patrol aircraft; satellite communication systems; airborne warning and control systems;

"Airborne surveillance sensors, defense-suppression weapons and systems; deep-strike tactical aircraft; aircraft carriers; guided ordnance; air-to-air superiority weapons; man-portable air defense systems; close support helicopters, aircraft and aerial weapons; long-range transports and artillery munitions."

MG Sammet Reviews Prototype Concept

Praises Overall Effectiveness of Army Approach To New Weapons Systems Acquisition Process

Deputy Chief of Research and Development Maj Gen George Sammet Jr. discussed "The Army Approach to Prototyping" in an address Feb. 24 to the National Security Industrial Association Prototyping Seminar in St. Louis, Mo. He reviewed the background of military materiel prototyping efforts, the management philosophy supporting this approach, and the current status and procedural requirements of prototype programs. His address follows:



During Mr. Packard's term as Deputy Secretary of Defense, he sensed a need to overhaul the weapon system acquisition process.

No matter how justifiable the reasons may have seemed to those involved in the weapons development business, the soaring costs and bad publicity associated with cost overruns and alleged premature fielding of systems demanded a new approach.

One of the steps, taken as part of this change, was to establish greater use of a procedure called prototyping. Its objective is simply stated in the phrase "fly-before-buy."

When the phrase "fly-before-buy" was first heard, many people jumped to the conclusion that it meant sequential development and production—elimination of concurrency—stretched-out programs—considerably more testing—and added program costs.

To a degree, Mr. Packard did mean some of these, but it is now my impression that all of the ominous things I just listed were secondary to what he really had in mind—more prototyping!

It is also my impression that Mr. Packard's real goal was not prototyping per se. He was as much interested in the accompanying management techniques—streamlined as they were—as he was in any piece of hardware which may result from prototyping. Perhaps even more so! I think he was using prototyping as a foil to cut through bureaucracy.

Prototyping, as a spotlighted procedure, may well disappear from the scene. But if in its wake are left better management procedures, then I say well done. Mr. Packard gave his definition of prototyping last fall at an NSIA Seminar in Washington. He explained that the experimental prototype was not to be confused with component prototyping or engineering prototyping.

Rather, these were experimental pieces of hardware, for which there



MG George Sammet Jr.

might or might not be an existing approved service requirement and which may or may not eventually go into production.

The goal of this prototype is to reduce technical uncertainty, to prove out feasibility or to give the Service more than one option. Now this is *not* an altogether new concept to the Army, having been used numerous times in the past.

For my first example, I go back 150 years. Shortly after the War of 1812 the Army became interested in breech-loading rifles. As a result of an RFP (Requirement for Production)—or maybe it was an RFQ (Requirement for Quality)—a number of contractors submitted actual hardware examples for evaluation.

John Halls' design was accepted. He was told to manufacture a limited number and these were issued to the only rifle regiment in the Army in 1820, at that time stationed in Nebraska, for test and evaluation. As it turned out, the rifles were found to be unsatisfactory and were never adopted.

In 1962 two good examples of prototyping surfaced—the light observation helicopter (LOH) and the special-purpose individual weapon (SPIW).

In the case of the 1962 LOH program, the Army went out with mission-type description only, limited the contractor responses to 35 pages, selected two winners, and told them to deliver FHA-certified flying prototypes. If they met the requirements, the companies got paid.

A third company joined in, saying to the Army, "Your evaluation team said it was impossible to do what we proposed, but how can you lose? If we don't produce, we don't get paid."

You all know the results—the Army got three good prototypes.

Also in 1962, the Army went out to industry with RFPs for the SPIW program. Competitive experimental prototypes were fabricated by the Army's

Springfield Armory and three companies. The result was an award to Aircraft Armanents, Inc. to continue development.

The program is still active—the newest AAI development models are now undergoing field experimentation at Fort Ord, Calif. This is probably the best example where prototypes were fabricated with no commitment to production. Now, ten years later, we still aren't committed to production.

I don't know if it is significant or not, but unlike the LOH, where we had minimum Army monitorship, in the SPIW case we had maximum Army monitorship. But I guess that is natural—everybody in the Army is an expert in rifles. Ten years ago nobody in the Army was an expert in helicopters. But give us time—we're finding helicopter experts all over these days.

There are other examples, like the Cobra attack helicopter which, 25 months after it was described to the Army, was in combat in Vietnam. But these are sufficient to make the point that we are not entering a totally new arena. We've been there before.

Rising costs of ever-increasing sophisticated systems forced us to look for a less costly method, and so we tried the paper approach. This has not proved to be the solution. So now we're going back. As the expression goes: "There ain't no learnin' like doin'!"

We are now going back, but there are some major differences in the format. *One of these* is there is no requirement for a requirement—at least not a formally stated requirement—before funds can be allocated to a proposed advanced development, or as it is now called, experimental prototype program.

This allows industry more latitude in pursuing what you may view as a potentially useful military application, and the Services the latitude of funding without the sine-qua-non of an existing formal requirements document.

A *second difference* is the clearly stated philosophy that, from the onset of the prototype contract, there is no commitment to production—even though an experimental prototype may prove a technological success.

The intent is simply to resolve technical uncertainty, and present to the user a working piece of hardware for his determination as to whether he believes he has a true need for the system.

A *third change* involves a streamlining of the administrative processing of prototype contracts. In my talk to the NSIA group last fall, I gave full credit to the Air Force for taking the initiative in seeing how simple this process could be made.

The Air Force discovered federal laws required that certain steps be taken and

that certain clauses be included in contracts. There was an irreducible minimum. But in view of the fact that the intent of the contract is really exploratory in nature, much of the definitive description of what was being sought could be eliminated.

The Army has followed suit, coming up with procedures designed to reduce the routine administrative load and usual delays in the award of contracts for experimental prototypes.

First, two approaches in program management are being considered by the U.S. Army Materiel Command for handling the prototype programs. One is to accomplish procurement at Headquarters AMC; the other is to have the cognizant subordinate command handle the procurement under a single AMC point of contact. In either case, implementation will be by small selected teams of capable people.

Second, Source Selection Authority. This authority will fall where the procurement is done: Headquarters AMC or the cognizant subordinate command.

Third, Determination and Findings. A D&F (Determination and Findings) will still have to be prepared for each prototype system or portion thereof that is readily identifiable as a separate and distinct effort. The law, here, is quite clear: there is no getting around the requirement for a D&F, so this aspect may not be eliminated.

However, my office has suggested to the field, as a means of saving considerable administrative lead time, that as soon as the Army Materiel Command has a sufficient grasp on a prototype program, they get their D&F paperwork into Army staff channels. It can then be acted upon, approval given, and returned to the command for execution as soon as money is made available and the program is approved.

Fourth, Request for Proposals. RFPs will contain, as a minimum, the scope required—in sufficient detail to permit development of a piece of hardware and to give its performance objectives—and concise procedures to determine performance and contract satisfaction.

RFPs will be limited to 25 pages, and include the law-required phrases, and will stipulate that the contractor response be no longer than 55 pages. Thirty days will be allowed for solicitation.

Fifth, Contractor Proposal Evaluation. This will be done by selected members of the teams formed to implement the program, normally 4 to 6 persons. A period of 15 days will be allowed for evaluation, which will be subjective and narrative in type rather than a weighing and scoring approach. Contractor capability will be the major consideration in source selection.

Sixth, End Product Evaluation. Prior to release of the RFP, the team responsible for the system to be prototyped will assure itself that the RFP contains information for both the contractor and those required to judge the degree of success, to evaluate completely the hardware produced.

Both the contractor and the government must be in complete accord as to the functions the system is expected to perform and the conditions under which this performance will be demonstrated.

Seventh, Contracts. The contracts will be of the cost-plus-fixed-fee type, with a monetary ceiling in most cases.

Eighth, Competition. The objective in prototyping is to reduce technical risk. To this end, competition will be actively sought at the outset, so as to obtain, within funding limitations, the maximum number of competitors—and therefore, possible solutions to a problem.

In this connection, the House Appropriations Committee stated specifically that at least two companies should participate in order for the government to obtain maximum advantage.

The end product evaluation should result in selection of a winner, and the winner would then continue development, if the project is to be carried on. In selected cases, however, the Army will consider a sole source.

Ninth, Contract Audits. There is an Armed Services Procurement Regulation that requires government contracts to be audited prior to award. This is the responsibility of the Defense Contract Audit Agency. This agency has already been alerted to the imminent and continuing need for expedited audit of experimental prototype contracts.

Tenth, Funding. When funds are received by Headquarters Department of the Army for prototype projects, they will be released to the Army Materiel Command in the usual manner, but will be specifically identified by that agency to insure visibility.

Eleventh, Technical Supervision. Once the contract is signed, supervision of contractor performance will be by the representatives of the developing agency. It may be in the form of periodic visits or by placing a representative full time at the contractor's plant.

Twelfth, Progress Reports. A quarterly report, in the form of a 20 to 30-minute briefing, will be made by the AMC developing agency to Headquarters AMC. In addition, we will continue to modify, as conditions require and as they allow, the administrative aspects of the prototyping effort to make them as expeditious and simple as possible.

Now, where do we stand in the real world of prototyping?

Last fall I listed for an NSIA audience

the Army's new initiative and prototype programs which were being considered for the FY 73 budget request. Included in this list were 15 proposed prototype projects. Five of the 15 were those already proposed to Congress for FY 72 funding. We included these 5 again in the FY 73 request, in the event they did not—and they did not—get added to the 72 program.

Since that time, two factors caused a few changes in program content. *First*, Congress did not grant us any money for the FY 72 program to do prototyping. It has been said that Congress heartily approved of the concept. I think that is an overstatement.

The House Appropriations Committee endorsed the concept to the fullest—but was concerned that the Department of Defense did not follow through by putting its own money where its mouth was; the committee was also concerned that the concept was not applied to some of the higher priority projects.

The Senate Appropriations Committee encouraged the construction of prototypes, but was more interested in engineering prototypes than experimental prototypes. Both Appropriations Committees either stated directly or inferred that competition was a desirable quality in prototyping.

The Senate Armed Services Committee's comments were couched in guarded conservatism—"prototyping, applied selectively, may lower development cost . . . may reinforce the technology base . . . may provide a means of reducing technical uncertainty." The committee was impressed by "potential value" and encouraged its "prudent use."

The result of that word-gaming was that Congress stated that if the Army really felt it was interested in experimental prototyping, it could embark on this program by diverting other FY 72 funds—but even then we had to go back to Congress for prior approval.

All of which says that Congress was reserving any full and total endorsement, pending more evidence. We in the Army must present our case better.

The second influencing factor was the FY 73 budgetary constraint which made us lower our sights. What evolved for FY 73 is a list of 8 prototype proposals; 3 of these are hold-overs from the original 5 submitted for FY 72; 4 are hold-overs from the remainder of the original FY 73 list; and one additional has been added.

I'll start my review with the three that were part of the 72 list. *The air defense suppression missile* is one on which the Army hopefully is moving out—a D&F (determination and findings) is now being processed—in advance of funds being available. We are going

(Continued on page 44)

AURORA FACILITY

Defense Nuclear Agency's unique simulator, operated by Army's Harry Diamond Labs, is most powerful tool for electronics 'hardening'

Imagine that for 100 billionths of a second, more than 20 times the combined output of all the world's electrical power generators could be focused in a single burst of power.

Sounds wild? Not really! In fact, production of such power for controlled simulation of nuclear weapon gamma ray effects will become routine when the Aurora Facility begins testing electronic components of the Spartan missile, a major component in the Safeguard ABM System, in April.

In the truest meaning of the word, the Aurora Facility is unique. Nothing remotely resembling its simulated nuclear explosion capability exists anywhere than on the site of the future home of the Army's famed Harry Diamond Laboratories at White Oak, Md.

Conceived and brought into being over a 6-year period by the Defense Nuclear Agency (DNA), formerly the Defense Atomic Support Agency (DASA), the Aurora Facility will be operated for DNA by Harry Diamond Laboratories.

Designated as the Army's Lead Laboratory for nuclear weapon effects studies by the U.S. Army Materiel Command, HDL has pioneered in similar studies for more than a decade. HDL's first radiation pulse reactor was dedicated in January 1962. (See "DORF . . . 10 Years Later," January-February 1972 edition, page 31.) HDL scientists and engineers also participated in design of the Aurora Facility.

Aurora's mission is described tersely: "To provide laboratory simulation that will lessen dependence of the nation on underground nuclear tests to insure that testing of weapon systems for defense can be effectively accomplished."

While the Aurora Facility cannot simulate all effects a real nuclear explosion might have on electronic components of weapon systems, it can approximate realistically some effects at a fraction of the cost. Underground nuclear tests cost millions of dollars for each "shot." A typical Aurora Facility experiment will cost "on the order of \$2,000 per shot."

Furthermore, experiments that would take many nuclear bursts to gain desired data can be done in a day at Aurora—and done under laboratory rather than field conditions. The future of the facility also may include modification of the photon spectrum and extraction of the electron beam for direct experimental use.

Stressed strongly during an interview with Aurora Facility officials is that "there are no inherent explosive characteristics"—meaning that the safe operation of the facility is well assured. Another key factor: "It will have negligible radiation impact upon the environment."

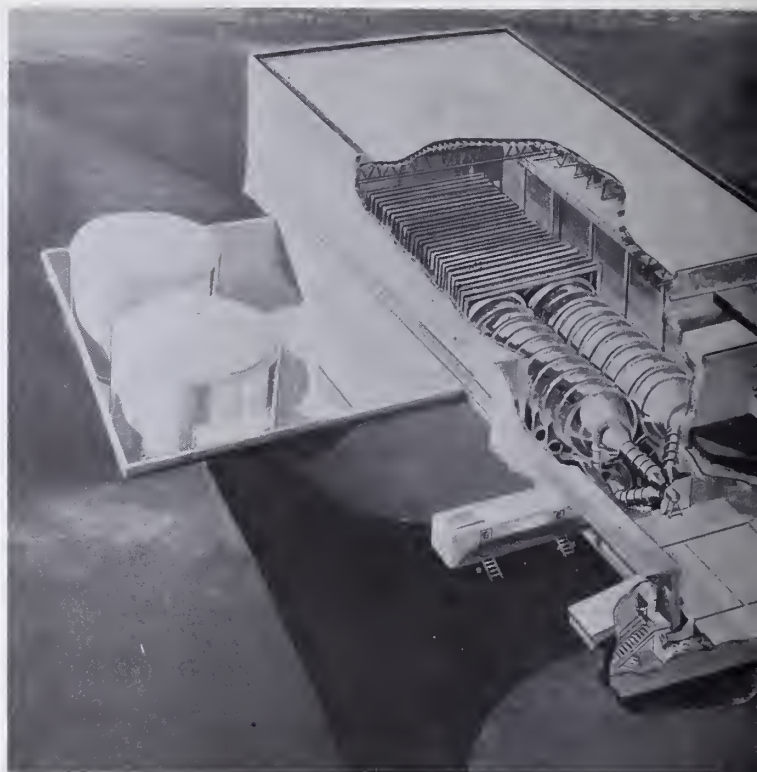
Capable of producing about 40 times the volumetric dose output of its closest rival, the Aurora Facility was constructed at a cost of about \$16 million. This figure includes engineering design, the flash X-ray machine and other equipment, and the massively impressive monolithic concrete building.

Actually, Aurora's two nearest rivals in the field of nuclear radiation effects studies are predecessors in the almost incredibly rapid advance in the state-of-the-art of nuclear radiation simulation since 1962.

Closely similar to each other in radiation capabilities, the first of these forerunners was built by Physics International for operation by the Air Force at Kirtland Air Base, N. Mex. That was followed by the one built by the Atomic Energy Commission at Sandia Laboratories, Albuquerque, N. Mex.

The facility produces an ionizing environment over large volumes for testing whole systems or key subsystems. Its nominal output is a 50,000-rad (silicon) free-field environment in a cylindrical volume one meter in diameter and length. That output is about 100 times the dose which, in case of human exposure, would result in a 50 percent probability of death.

The instantaneous power output, for one hundred billionths of a second, is rated at 24 million megawatts (24 billion kilo-



Aurora flash X-ray machine is housed in this 40,000-square foot building. More than half of this is the 204 x 108-foot machine bay, which is 70 feet high. The building also includes a test cell shielded by earth and concrete, an office, laboratory and utility areas. At the left are two 800,000-gallon tanks that store insulating oil for the 7,000-ton gamma ray effects machine.

MAJ CLAYTON S. GATES, Aurora Facility project officer, has served with the Defense Nuclear Agency since he returned from a 1968-69 duty tour in Vietnam. There he served with the 79th Engineer Group and then as executive officer, 168th Engineer Battalion.

Graduated from the United States Military Academy (Class of '56), he served for two years with the 326th Engineer Battalion, 101st Airborne Division. After a year with the 11th Engineer Battalion in Korea, he attended the University of Illinois under the Army's advanced education program for officers. He was awarded an MS degree in civil engineering in 1961 and an MS in nuclear engineering a year later. Currently, he is a night-school student at Georgetown University Law Center.

MAJ Gates' father, a 1933 U.S. Military Academy graduate killed in World War II, was also a Corps of Engineers officer and a brother of BG Mahlon E. Gates, currently Army Materiel Command Deputy Director of Research, Development and Engineering. MAJ Gates' brother, Richard H. Gates (USMA Class of '60), is serving as deputy director, U.S. Army Engineer Explosive Excavation Research Office, Corps of Engineers Waterways Experiment Station, with duty at Livermore, Calif.

Born in Walter Reed General Hospital, Washington, D.C., Dec. 29, 1934, MAJ Gates has devoted much of his time to the field of nuclear engineering for the past decade. In 1962 he was assigned to the Nuclear Power Field Office, U.S. Army Engineer Reactors Group, Fort Belvoir, Va., when Army Chief of R&D LTG William C. Gribble Jr. (then COL) was Director of USAERG (now U.S. Army Engineer Power Group).

PAUL A. CALDWELL, Aurora Facility director and chief of HDL Branch 290, came to the Harry Diamond Laboratories in 1959 to join the Nuclear Vulnerability Branch.

While at the University of Minnesota, he worked two years on the Manhattan Project, contributing to the design and development of the analytical mass-spectrometers used at Oak Ridge, Tenn., to assay the products of the uranium separation systems.

In 1942, he joined the Centimeter Wave Research Branch of the Naval Research Laboratory (NRL) to design microwave radar countermeasures systems and components.

After WWII, he transferred to the Physics Division (later the Nucleonics Division) at NRL, where he became involved in the nuclear weapons testing program. Caldwell participated in many overseas and Nevada Test Site experiments, primarily determining the effect of nuclear weapon radiation on propagation of electromagnetic energy.

Project officer of YUCCA, one of the three first high-altitude tests, he also was responsible for the Defense Atomic Support Agency (DASA) nuclear radiation output measurement in the Teak and Orange atmospheric experiments. On joining HDL, he continued nuclear weapons effects work as project officer for "Small-Boy" and most subsequent DoD LOS (Line-Of-Sight) tests, performing nuclear radiation output measurements to support the DASA TREE (Transient Radiation Effects on Electronics) and EMP (Electromagnetic Pulse) programs. He was DASA technical director for the "Milk Shake" (underground) shot.

Caldwell has participated in the development of simulators for the high-intensity prompt gamma-rays from weapons since simulation first appeared possible. As a charter member





of the DASA ad hoc advisory group in this area, he had been involved with the Aurora Facility program from its beginning.

Some 30 publications, reports and invited papers have resulted from his work. In 1943 he received a BA degree from the University of Minnesota, and has continued graduate studies, primarily at the University of Maryland. He is a member of the American Physical Society, the Association for the Advancement of Science, the Research Society of America and the Institute of Electrical and Electronics Engineers (IEEE) Group on Nuclear Science.

ALEXANDER G. STEWART, who joined HDL in 1968 to work on the Aurora project, is responsible for operation of the simulator portion of the facility.

Most of his professional life has been devoted to the areas of pulse power or nuclear radiation effects. Born and educated in Scotland, he began his professional career in 1959 at the Atomic Weapons Research Establishment, working on unconventional means of generating pulse power.

In 1962, he came to the United States to join the Ion Physics Corp. as group leader in gas-switching research. As program manager for flash X-ray generators, he was responsible for several now in use both in this country and abroad. The Harry Diamond Laboratories HIFX generator, one of those built during this period, won the IR 100 award for industrial design.

After a short venture into the aerospace industry with Philco-Ford, studying the effects of nuclear weapons and space radiation on satellite systems, he moved to the staff of HDL. Twelve publications and reports have resulted from his work.

Graduated with a BS degree (with honors) in 1953 from the University of Strathclyde, Glasgow, he continued graduate work in England until coming to this country. He is a member of the British Institute of Physics, and the Institute of Electrical Engineers.

ROBERT C. LAMB is responsible for the data recording instrumentation system at Aurora. Employed at HDL since September 1966, he has worked in the nuclear weapon radiation measurement program, serving as project officer or deputy on several tests at the Nevada Test Site.

Lamb worked at EG&G (1961-66) in the Reaction History Group, which performs nuclear weapons diagnostics for the AEC and was head of that group when he left to join HDL. He has participated since the beginning of design of the Aurora instrumentation system, and is credited with contributing much to the design of the entire facility.

Lamb began his U.S. Government career in radioastronomy at the National Bureau of Standards Boulder (Colo.) Laboratory in 1956. His publications range from "Amplitude and Angular Scintillations from the Radio Source Cygnus-A" to "Scattered Gamma and Neutron Measurements by Time-Resolved Dosimetry (Shot Minute Steak)."

The University of Colorado granted him a BS degree in 1958 and he has since completed numerous specialized graduate level courses. He is a member of the IEEE Group on Nuclear Science.

watts). The stored energy of the Marx generators is about 5 million joules.

Controlled power such as that (as opposed to the "uncontrolled" power of a bomb) was simply unachievable less than a decade ago. The Aurora Facility is designed to accommodate several tests a day, producing that power to simulate nuclear radiation effects—thereby attesting to the rapid advance in this technology.

Historically, the cycle leading to the Aurora Facility began in the early 1960s when military leaders recognized that the nuclear threat required advanced knowledge to assure the survival of weapon systems during all phases of their planned missions.

Concept feasibility studies (Phase I) for the Aurora Facility followed a Joint Chiefs of Staff decision in early 1966. Results provided a basis for the Director of Defense Research and Engineering to authorize Phase II engineering design and development in 1967. A contract was awarded to Physics International in June 1968.

Phase I was initiated by close collaboration between Dr. N. F. Wikner, then DASA Deputy Director for Science and Technology; Peter H. Haas, his special assistant; MAJ Carlton Jones, then the DASA project officer for the Aurora Facility; and Frank J. Thomas, then Assistant Director of Defense Research and Engineering (Nuclear Programs).

DASA formed an ad hoc group of experts to specify a simulator that was both useful and possible, and to evaluate the engineering feasibility of the available approaches.

The Aurora Facility concept involved the exceedingly difficult technical problem of integrating the output of four Marx generators and four Blumlein pulse-forming networks (named after Erwin Marx and Alan Blumlein, British scientists who invented the circuits involved, in the 1930s) and to synchronize their output in a small focal volume in 100 billionths of a second.

Phase II entailed a 3-stage design development and review process conducted from June 27, 1968, through July 25, 1969. Technological results were incorporated in the Aurora Diode Experiment (ADE).

The ADE decision called for construction and testing of all components for one Marx generator (one-fourth the capacity of the Aurora simulator) and its associated pulse-forming network and X-ray diode at Tracy, Calif., near the San Leandro headquarters of Physics International.

The full rated output of the ADE generator was achieved in May 1970 with storage and discharge of 1.2 million joules, the greatest energy release ever achieved from a single Marx generator.

Eighteen months of design development provided the technological base to proceed with Phase III construction of the Aurora Facility on the HDL site, beginning in December

(Continued on page 26)



From left—Alexander G. Stewart, Robert C. Lamb, Paul A. Caldwell

AURORA FACILITY

(Continued from page 24)

1969. The building was designed by Gilboy, Stauffer, Giombetti, Skibinski and Davies, Architects and Engineers, Clark's Summit, Pa.

Blake Construction Co. of Washington, D.C., supervised by the Chesapeake Division of the Naval Facilities Engineering Command, progressed with building construction sufficiently by July 1970 so that assembly of the machine could begin.

The completed building was accepted from the Chesapeake Division by DASA, later renamed the Defense Nuclear Agency, in January 1971. The Naval Ordnance Laboratory had provided the site for the facility as part of the agreement to turn over 137 acres for the Harry Diamond Laboratories' future home, scheduled for completion in 1974.

In April, some six months of intensive activation testing of the nuclear blast simulator and instrumentation will be concluded. Two months of transient radiation effects testing will then begin on electronic components for the Spartan missile.

Following the Spartan tests, the facility will be available to systems project offices of the Military Departments and their contractors concerned with simulating ionizing radiation effects on weapon and satellite systems.

The Aurora Facility presents an impressive view to visitors. A security clearance is required, however, and the view will be limited to those having a legitimate requirement to enter the building.

"Mind boggling" is not even a mild exaggeration in describing the impression one gets upon seeing the convergence of four huge independent electron beam sources at the target area—the exposure window leading into the high-ceilinged 65 by 48-foot test cell.

Equally staggering to one's ocular reaction is the 135-foot-long view down the aisles between the four Marx generators—each consisting of 96 capacitors linked by a maze of metal, liquid and gas circuitry, including blue-green plastic resistor lines filled with copper sulfate.

Immense is a word one is tempted to overwork in describing the complex facets of the Aurora Facility. For example, 1,750 tons of steel went into the supporting framework and the tanks containing the Marx generators and Blumlein networks.

When filled with insulating oil, the tank (135 feet long, 60 feet high and about 50 feet wide at the Blumlein end) contains 1.5 million gallons weighing nearly 6,000 tons. When not used in testing, the oil empties rapidly into storage tanks outside the building.

Another surprising aspect is that the entire machine can be hydraulically jacked off the floor, set on wheels and easily moved a distance of 70 feet on railroad tracks for maintenance purposes. A hydraulic ram moves the machine structure in 14-foot stages.

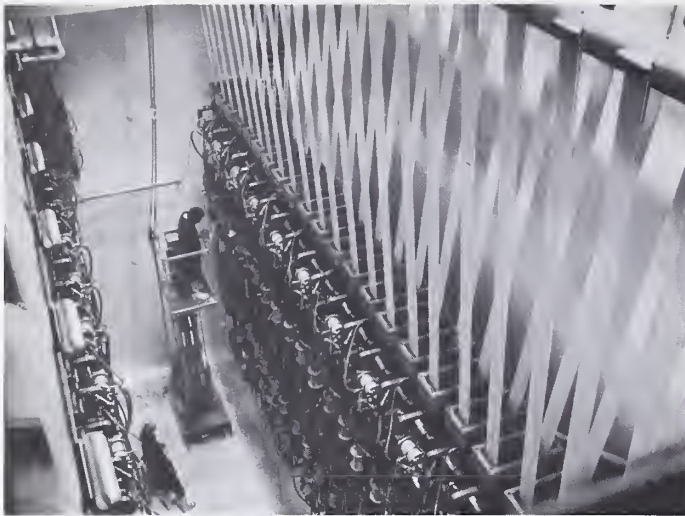
TEST CELL. Exemplifying the rigid radiation safety considerations that have figured in the design of the Aurora Facility is the test cell, which is surrounded by a 10-foot-thick shield of concrete and earth. This and other shielding precautions are sufficient to insure that radiation received by facility personnel is kept well within Atomic Energy Commission standards.

The test cell is also enclosed by a continuous metal shield, to reduce the electromagnetic interference with the environment. From the test cell, cables transmit test results to an electromagnetically shielded data room, where the results can be recorded on 25 oscilloscope channels, 100 slow data-scanner channels, and 46 high-speed tape channels.

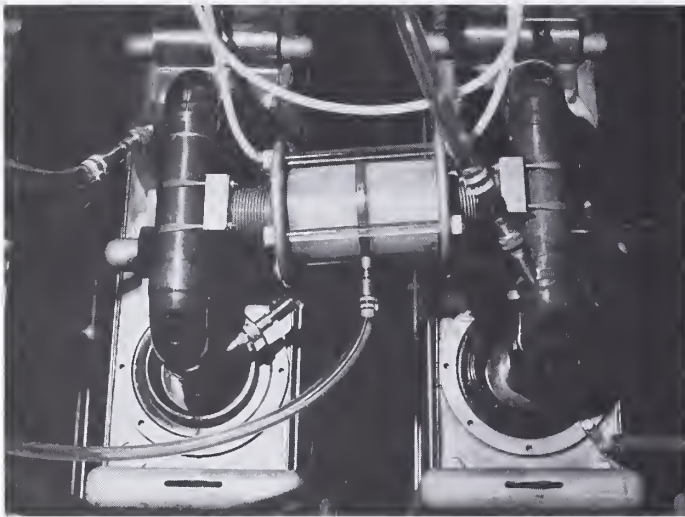
The data room is sufficiently large to accommodate other user-provided equipment for test specimen conditioning and data recording. Two optical viewports also are provided.

All automated operations are controlled by a countdown clock, from minus 300 to plus 300 seconds. Clocks in the data and control rooms are synchronized, and times can be displayed remotely elsewhere in the building and in a trailer park which is available to users. Provision is made for both automated and manual firing "holds."

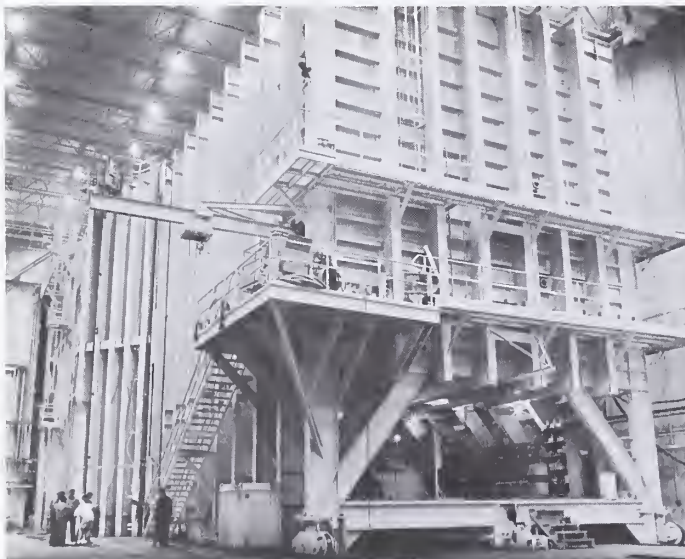
Aurora Facility users are provided with two 16 × 28 foot set-up rooms exterior to the test chamber. Equipment of



Interior view of Marx generator tank showing suspension of banks of capacitor stages by system of nylon straps. When the machine is being operated, this tank is filled with insulating oil.



Close-up of two Marx generator stages connected by a gas-insulated 3-electrode switch and copper-sulfate resistors.



Rear view of Marx generator tank showing framework of steel supporting beams. Tank is 60 feet high, 135 feet long, and 55 feet wide. The machine can be lifted hydraulically and rolled back 70 feet, by using a hydraulic ram, for maintenance work.

users may be brought in directly from the loading dock and assembled in the staging area, 29 × 34 feet.

Dosimetry, electronic and high-voltage laboratories are reserved for the use of Aurora personnel. Behind these labs are the Aurora staff offices and a small conference room. The simulator bay, control room and control room office will be used only by those responsible for operation of the simulator. A dark room is available to users by arrangement.

THEORY OF OPERATION. Flash X-ray machines to simulate nuclear radiation effects are in many ways similar to medical X-ray machines. Machines like the Aurora have been used for many years in flash radiography as one means of nondestructive testing.

Detonation of a nuclear weapon produces large quantities of radiation, including X-rays, gamma rays and neutrons. In passing through air or any other medium, radiation is partially absorbed by transferring its energy to the medium in the form of ionization and heat. This is what causes the brilliant flash of light and the shock wave when a nuclear device is set off in the atmosphere.

If the radiation in space encounters an object such as a satellite or a missile, it causes the same ionization and heating, and also displacement of atoms in crystals. These effects can result in malfunction of the missile or satellite.

A flash X-ray machine produces photons. ("Photon" is a word used to describe radiant energy like X-rays or gamma rays; ordinary visible light is made up of these photons.) When a missile or satellite part is placed in the field of photons produced by a flash X-ray machine, it reacts in many ways as it would if it were "seeing" the radiation produced by detonation of a nuclear weapon.

The Aurora flash X-ray machine, as mentioned in the beginning of this article, is the largest in the world. Its operation begins with the electrical charging of four Marx generators. In such a generator, capacitors are slowly charged in parallel to, say, 100 kilovolts. Then, triggered switches cause these capacitors to be discharged rapidly in series. If there are, say, 100 stages each charged at 100 kv, the output voltage of the generator will be ten million volts.

This voltage is applied to a pulse-forming network, in order to "tailor" the voltage pulse to the shape and time length desired. At the proper time, another switch applies the tailored voltage pulse to the cathode of a large X-ray diode.

The voltage at the cathode causes electrons to be accelerated to an anode, where they release part of their energy in the form of photons. These photons are then allowed to impinge on a test specimen and the response of the specimen is recorded.

IN SUMMARY, the purpose of the Aurora Facility is to provide a capability for ionizing radiation testing of large electronic components of weapon and satellite systems—currently to complement underground nuclear testing, and to bear an even heavier load if underground testing should be abolished.

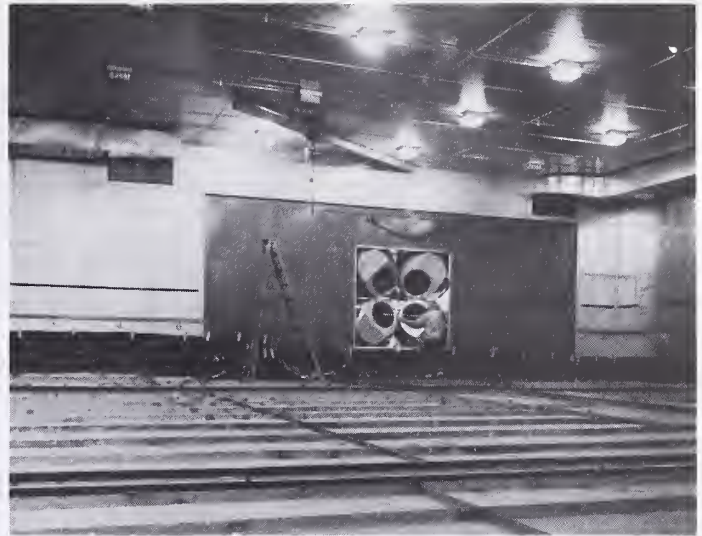
That mission involves "hardening" of existing systems to assure their protection against nuclear radiation, plus acquiring new knowledge to design survivability into advanced systems at the proper time during development.

Developers can test their systems or key subsystems in a simulation of the ionization environment in which they are designed to survive, record data responses to tests, and determine if the design is acceptable from a survivability viewpoint.

The introductory paragraph of this article should perhaps be set in its proper perspective with regard to time and power. The thought of the world's total electrical power generator capability being exceeded more than 20 times by a pulsed power source for 100 billionths of a second (one-tenth of a microsecond) may have intrigued you.

But, as all scientists know, considerations of power must properly be related to time. Translated into a layman's reference for understanding, that amount of power for that period of time represents the energy required to operate a 100-watt electric light bulb for seven hours.

Or, in terms of the combat veteran, the five million joules stored in the Aurora Facility Marx generators is roughly equivalent to the energy from detonation of 2½ pounds of TNT, that is, roughly the energy packed in 6½ hand grenades.



Interior view of 65 by 48-foot test cell with the four bremsstrahlung-producing anodes converging at the exposure window.



Concentric rings of aluminum, shown here in interior of vacuum tube, separate 40 lucite rings that form the oil-vacuum interface and also insulate the generator cathode from the anode.



Technician Larry Sanders of Physics International Co., prime contractor for Aurora Facility, inspects one of four Blumlein pulse-forming networks integrated for simultaneous firing.

In-House Laboratories . . .

Briefing on 10-Year-Old ILIR Program Cites Stimulating Effect, Advances in State-of-Art

Qualities of durability can properly be attributed to a U.S. Army program that survives substantially without change for more than a decade, and the In-House Laboratory Independent Research (ILIR) Program recently advanced into that category.

Origins, objectives and some of the notable achievements and ongoing efforts in the ILIR Program are explained in a recent briefing presented by COL Robert E. Ingalls, chief of the Research Programs Office, Office of the Chief of Research and Development.

ILIR tasks are performed currently at 42 Army laboratories and test centers, he reported. About 450 tasks have a budget of \$11.1 million, averaging roughly \$25,000 each. This level of funding has remained relatively constant since the inception of the program in October 1961.



COL Robert E. Ingalls

The Secretary of Defense directed initiation of ILIR in a memorandum to the secretaries of the Military Departments. It stated in part:

"Depending upon the mission and nature of the work of the particular laboratory, a fraction of the annual laboratory budget shall be set aside for work judged by the laboratory director to be of promise or importance, without need of prior approval or review at higher levels. The results of this work shall be reviewed by the assistant secretaries for research and development of the Military Departments."

Some of the primary reasons for ILIR funding are described in the 1962 report of the Bell Committee chaired by David E. Bell, then director of the Bureau of the Budget (BOB). Some of his statements included:

• "Contractors have often been able to provide a superior working environment for their scientists and engineers" (compared to government labs, thus making contractor employment more desirable).

• "It has often seemed that contractors have been given the more significant and more interesting work assignments, leaving government R&D establishments with rou-

time missions and static programs which do not attract the best talent."

Recommendations to correct deficiencies included: "Providing the research laboratory director a discretionary allotment of funds, to be available for projects of his choosing, and for the results of which he is to be responsible."

Army Regulation 70-55 established ILIR objectives as follows: "This program is instituted as one aspect of a broad approach to provide Army scientists and engineers an additional opportunity to maintain and increase their competence by doing original work in areas suiting their talents, thereby promoting a vigorous internal research program of the highest caliber. The primary purpose of these funds is to strengthen the scientific and engineering competence of R&D centers and laboratories."

An informal but important objective of ILIR is to reduce "bootleg" work in the laboratory by making such tasks legitimate. By using ILIR channels, the scientist can request funds for research of individual interest which he deems important. This requires the laboratory director's appraisal, serving to fix the

real price tag associated with each specific laboratory effort.

COL Ingalls emphasized that the ILIR Program is oriented to the mission assigned to each laboratory, in accordance with the policy detailed in the May 1970 change to AR 70-55.

The regulation specifically states that ILIR funds will *not* be used to support outside or contract work except that required for research done by in-house personnel in the execution of a task under this program.

Dr. K. C. Emerson, Assistant for Research to Assistant Secretary of the Army (R&D) Robert L. Johnson, chairs the annual review committee. Members scrutinize each Department of Defense Form 1498 Research and Technology Work Unit Summary, as well as the laboratory director's letter report, to judge the mission-oriented relevance, scientific merit, and obligation status of each task. Funding is then decided and allotted for the current year. The committee review takes place in August.

For FY 1972, the Army ILIR Program is funded at \$11.1 million. This equates to \$6.9 million in terms of FY 1965 dollars. The Navy is programmed at \$13 million and Air Force at \$5.3 million. The money is spent primarily for salaries of researchers, with small expenditures for equipment and outside technical assistance.

Laboratory directors' reports indicate they are enthusiastic about ILIR results. They appreciate the latitude, flexibility and freedom the program provides for research personnel, and feel it has a good early start payoff for exploratory and developmental programs. ILIR is credited with contributions to morale, recruitment, retention, and self-development of Army scientific personnel.

Army Research Deputy and Scientific Director Dr. Richard A. Weiss has stated that ILIR "provides a window through which top management can observe the stewardship exercised by the technical director on this small part. One may make an extrapolation and say the part represents the whole, thus giving OCRD and ASA (R&D) a good feel for the health and welfare of the technical director's over-all program. . . ."

ILIR Recent "Dividends"

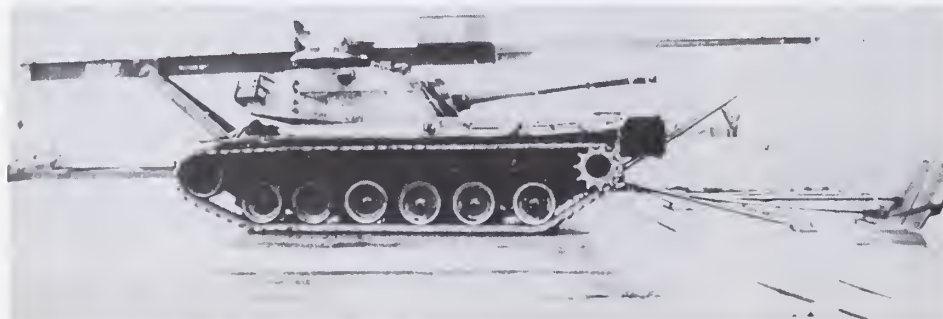
In his briefing COL Ingalls cited examples of ILIR payoffs. Edgewood (Md.) Arsenal, he said, has developed a grenade, shaped in the form of a ring, that "floats" in a flat trajectory. Less energy is required to fire the ring and it obtains longer distances than the old bullet-shaped grenade.

Frankford Arsenal in Philadelphia, Pa., has developed a better magnet material by combining cobalt with rare materials. A simplified fuzing design is possible because the compound eliminates the spin dependence used in conventional fuzes.

The fuze model has six small magnets. Researchers are still experimenting with the cobalt compound and it appears that the magnets will be almost indestructible insofar as retaining force is concerned. This is ex-

Picatinny Prototype Protects Personnel . . .

Designed specifically for use in Vietnam, this M48 tank was modified by mounting three electromagnets on the rear (left) and a special rake on the front (right) to clear munitions storage areas after they have been attacked. Bomblets and rockets scattered around after a disaster can be picked up and collected by this vehicle while protecting personnel doing the work. This equipment represents a prototype designed by Picatinny Arsenal, Dover, N.J., in response to a request from the Air Force Logistics Command following a Viet Cong sapper attack on an Air Force ammunition storage area in August 1971.



pected to permit use of much smaller magnets in the mechanical time fuze since a magnetic oscillation replaces the spring in the jungle-house escapement mechanism now reliant on the spin of the round.

The Natick (Mass.) Laboratories have developed a chemical compound sealed in a plastic pouch. Time and temperature exposure changes the chemical compound, enabling logistic storage personnel to identify items that should be issued first.

The Feltman Research Laboratory at Picatinny Arsenal has developed a telemetry system that can measure in-bore and terminal ballistic data heretofore not possible. The system can be linked to an analog computer to improve fuze designs. This is expected to eliminate many of the expensive prototype test firings now necessary in development programs.

The Electronics Command Avionics Laboratory at Fort Monmouth, N.J., has developed a device that can sense both positive and negative static charges accumulated on helicopters. This device can also dissipate the static charge, eliminating or minimizing the hazard of shock to crew members and the serious fire hazard in refueling operations.

The Mobility Equipment Research and Development Center (MERDC) at Fort Belvoir, Va., has investigated a device for reclaiming heat from engine exhausts. Engine generators now waste energy at the rate of four times the electrical energy produced. This device provides a simple inexpensive mechanism for heating communication shelters where a generator is operating nearby.

In their mine/counter-mine program, MERDC scientists have experimented with an acoustic capability to produce low-frequency, high-intensity sound, using reflectors, lenses and horns. One frequency looks very promising to serve as one element of a barrier system by stopping soldiers coming in contact with it. This original ILIR effort has now been transferred to a regular funding project.

The Army Engineers Waterways Experiment Station performed the theoretical work which led to constructing a model to develop the best size, and the best position above ground to explode a weapon to clear a forest area.

The model study dealt with different forest configurations to predict the area cleared and the tree stumps remaining. Then the model was fully developed with other than ILIR funds. This replaced the requirement for field tests.

The Army Engineers Topographic Laboratory researched the technology to rectify side-looking radar imagery used on existing stereoplotter equipment. The technology can now be used to produce maps of the four million square miles of cloud-covered areas of the world. The technique has effected major savings on equipment developments and procurements.

The Topographic Laboratory also researched stereoscopic technology to measure the size and volume of clouds on the NASA satellite photographs. This capability offers a new dimension to meteorological data collection and evaluation used in weather forecasts to support military planning and operations.

The Construction Engineering Research Laboratory (CERL), Urbana, Ill., has experimented with the concept of fibrous reinforced concrete. As a result, a stronger, more ductile,

energy-absorbing concrete is now being tested extensively for military and civilian airfield applications. In addition to much greater durability under heavy traffic than normal concrete, the fibrous type offers improved sound insulating qualities.

COL Ingalls ended his briefing by saying: "During a recent appearance on the CBS TV program, 'Issues and Answers,' Dr. John Foster (Director of Defense Research and Engineering) and Dr. Edward Teller agreed that the most important element in our race with the Soviets is technology. Dr. Foster went on to say that his greatest worry is people, espe-

cially our young people who are not interested in technology. He said our longest lead-time item is that of training people.

"The ILIR program is people-oriented. Currently, ILIR funding supports 450 tasks performed by Army scientists, out of a total of 14,000 professional personnel in Army laboratories.

"I think that it is a program to help solve the problems that we face. It is modest at 3 percent of our technology base (basic research and exploratory development) or 0.6 percent of the total Army research, development, test and evaluation budget."

Improvement Program Includes Pershing Firings

Pershing missile firings this spring will be part of a product improvement program conducted by the Missile Test and Evaluation Directorate, White Sands Missile Range (WSMR), N. Mex., for the Test and Evaluation Command (TECOM), Aberdeen Proving Ground, Md.

Scheduled for completion during the week of June 25, the missiles will be fired in April, May and June from Green River, Utah, to White Sands Missile Range. All the firings will be supported by the 3d Battalion, 9th Field Artillery from Fort Sill, Okla., whose members will fire the first round during the week of Apr. 16.

Fifteen rounds will be fired by units of the Seventh U.S. Army, returning for annual service practice firings from stations in Europe. Four rounds will be fired by elements of the Federal Republic of Germany Air Force.

Other participants include TECOM, the Pershing Project Manager's Office of the Missile Command (MICOM), Redstone Arsenal, Ala., and the U.S. Army Field Artillery Missile Systems Evaluation Group, Fort Sill, Okla.

Since the off-range program began in the fall of 1963, 150 Pershing missiles have been fired from off-range sites to impact on WSMR. Pershings have been launched from Gilson Butte, near Hanksville, and Black Mesa, near Blanding, as well as from Green River, all in Utah.

Most powerful of the U.S. Army's operational missile weapon systems, the Pershing is 35 feet long, 40 inches in diameter and weighs 10,000 pounds at launch. It travels at supersonic speed.

FAMECE Family Gains 'Dad' With Relyea's Appointment As First Project Manager

FAMECE, denoting Family of Military Engineer Construction Equipment, and the Universal Engineer Tractor (UET) have been placed under a product manager for continued research and development activities.

General Henry A. Miley, CG of the Army Materiel Command, announced the appointment of LTC George R. Relyea to the new position. He was formerly executive officer of the Army Mobility Equipment Research and Development Center (MERDC), Fort Belvoir, Va., which has exercised responsibility for the FAMECE and UET developmental programs.

Although LTC Relyea will report directly to the commanding general, Mobility Equipment Command in St. Louis, Mo., his office will be at the MERDC. He carries the full line authority of General Miley as delegated to the MECOM commander.

Centralized management authority for the two projects makes LTC Relyea responsible for planning, directing and controlling the allocation and utilization of all resources authorized for the projects.

FAMECE is a sectionalized, articulated or hinge-steering, pneumatic-tired earthmoving system, comprised of power, dozer, loader, grader, scraper, dumper, water distributor and compactor modules.

The concept for this family of equipment, which has been in development since 1967, is that it will replace wheeled construction equipment of comparable performance now authorized for combat engineer organizations.

The UET is a multipurpose tracked, armored combat engineer vehicle capable of performing dozing, scraping, rough grading, excavating and hauling operations. Designed to replace some of the medium crawler tractors and prime movers in combat engineer units, it has been in development for approximately 15 years. It is air-transportable, provides light armor protection, and has a limited swimming capability.

LTC RELYEA enlisted in the Army in 1945 and served as an enlisted man until 1948. Appointed to the U.S. Army Military Academy, West Point, N.Y., he received his degree and commission in 1952. Under the Army's advanced education program, he received his master's in civil engineering from the University of Illinois. He is a graduate of the Command and General Staff College, the Armed Forces Staff College, and the Army War College.

He has served in Korea, Europe and Thailand. In Vietnam, he was training director, National Defense College Advisory Detachment, until assigned to the MERDC in June 1971.

Included among his decorations are the Bronze Star with Oak Leaf Cluster, Joint Commendation Medal, Army Commendation Medal with four Clusters, and the Honor Medal, First Class, Vietnam.



Career Programs . . .

OCRD Profits by 'Proof of the Pudding' Experience In Selecting Record Number of Management Interns

Success of the Army Staff Management Intern Program (ASMIP) over more than a decade partially explains why the office of the Chief of Research and Development, Department of the Army, recently selected a record number of these outstanding university or college graduates.

Established by Chief of Staff Regulation 690-415, the Management Intern Program provides a procedure for selecting and training college or university graduates who offer high potential for rapid development as civilian employees in managerial and administrative positions.

Since the inception of the program, 10 ASMIP groups have been recruited and trained in General Staff agencies. Each year the high percentage of those who have more than fulfilled career potential expectations has justified continuation of the program.

Training consists of two phases extending over a 12-month period. During the first six months, the interns rotate through a series of temporary (6 weeks) assignments with different agencies in work related to their education, experience or career interests. They receive comprehensive orientation on the missions, organization and management of the Army. Rotational assignments are monitored by the Staff Civilian Personnel Division.

Agency officials evaluate the trainees during this period and decide who will be offered permanent assignments. This begins the second phase of training—on-the-job development to give the intern experience in his chosen field and prepare him for an Army civilian professional career.

In the order of alphabetical sequence of their names the OCRD management interns are:

John Michael Coleman is assigned to the Publications Branch, Technical Data Division of the Information Systems Office (ISO).

Graduated magna cum laude from the University of Georgia, with a BA degree in classics, he later attended the Candler School of Theology at Emory University under a dean's scholarship. He is a member of Phi Eta Sigma, Phi Kappa Phi and Phi Beta Kappa national honorary scholastic societies.

Donald J. Ertel, assigned to the Laboratory Review Office under the Director of Army Research, comes to OCRD from the University of Wisconsin, where



ARMY STAFF MANAGEMENT INTERNS employed by OCRD are (from left) Kenneth E. Roberts, Peter J. Paternoster Jr., James S. Sheldon, Julie K. VanAllen, James R. Sever, Eugene S. Groseclose Jr., John M. Coleman, Donald J. Ertel and Gary A. Young. Others not shown in photo include Donna Heivilin, Marilyn Rurak and John A. Stanley.

he received a BA degree in political science in 1971.

His intern rotations included assignments with the Assistant Chief of Staff for Communications-Electronics in the Spectrum Management Division; Management Information Systems Directorate, Office of the Assistant Vice Chief of Staff; U.S. Army Management Systems Support Agency (USAMSSA); and Office, Deputy Chief of Staff for Military Operations.

Eugene S. Groseclose Jr. has been assigned to computer systems analyst training in the Systems Design and ADP Division of ISO. He holds a BA degree in biology from Virginia Military Institute, and taught high school for a year in Bedford, Va., until he entered the Army.

While in the Army he served at Edgewood Arsenal, Md., as an administrative officer and then as chief, Military Personnel Division. Later, at Fort Riley, Kans., he was assistant division chemical officer, 1st Infantry Division.

Donna Heivilin is working in the Systems Design and ADP Division of ISO. Awarded five scholarships, she attended Iowa State University and earned a BA degree in psychology from the University of Minnesota. Certified by Southwest Texas State University as a teacher in psychology and special education, she served as a substitute teacher for the Judson School District, San Antonio, Tex.

She also was director of safety services for the Linn County Chapter of the American Red Cross, Cedar Rapids,

Iowa, and a research assistant in Opthamology at the University of Iowa Hospital.

Peter J. Paternoster Jr. is assigned to the Systems Coordinating Branch, Plans Division, Directorate of Plans and Programs. He holds a BA degree from Lehigh University with a major in mathematics and a minor in business.

Commissioned as a graduate of the Infantry Officer Candidate School, he has attended the Adjutant General orientation course, served in Ashaffenburg, Germany, and has a Reserve assignment with the 300th Civil Affairs Group.

Kenneth Earl Roberts is assigned to the Management and Evaluation Division, Directorate of Plans and Programs. He has a BA degree in international relations from American University and an MA degree from Florida State University as a fellowship student in international affairs/political science, both cum laude. He is a member of Pi Sigma Alpha.

He has taught with the Boys' Training Center, Milledgeville, Ga., and done community development and social work with the Department of Family and Childrens' Services in Fulton County, Ga.

Marilyn Rurak is assigned as an analyst with the Management Information Division of ISO. She has a BA degree in political science from Mt. Holyoke College, an MA degree in Asian studies (Chinese language) from the University of Southern California, and has attended courses at Washington University in St.

Louis and the University of Paris, France.

She has worked as a research assistant at the Institute of Political Studies, Stanford University, a teacher for Chicopee (Mass.) public schools, and as a reporter for the Holyoke (Mass.) *Transcript-Telegram*. She also was employed as a proofreader-copy editor for University Publications, Los Angeles, Calif.

James Riley Sever is assigned to the Test and Evaluation Branch, Management and Evaluation Division, Directorate of Plans and Programs. He has a BA degree in history, and an MA in history and higher education, both from Florida State University. He later taught Latin at Walton Senior High School, DeFuniak Springs, Fla.

James S. Sheldon is training as an analyst in the Material Needs Branch, Plans Division, Directorate of Plans and Programs. He has attended the University of Toronto, has a BA degree in psychology from Syracuse University, and has studied psychopharmacology at Vanderbilt University.

His military schooling includes a fire direction control course at Fort Sill, Okla., and a ground sensor course at Fort Huachuca, Ariz. While in Vietnam with the 1st Cavalry Division, he won the Bronze Star Medal with 1st Oak Leaf Cluster and the Air Medal.

John A. Stanley is assigned to the Trend Analysis/Net Technical Assessment Team, Plans Division, Directorate of Plans and Programs. He has a BA degree in political science from the University of Georgia, and while in Germany studied in the University of Maryland extension program.

While serving in the U.S. Air Force, he attended the Electronic Intercept Operations and Analysis School, Keesler Air Force Base, Miss.

Julie K. VanAllen, who has a BA degree in political science from Vassar College, is assigned as a program progress analyst, Management and Evaluation Division, Directorate of Plans and Programs.

Her intern rotations included assignments with the Adjutant General's office, the Office of the Chief of Staff for Logistics, USAMSSA, and the Behavior and Systems Research Laboratory of the Manpower Resources R&D Center.

Gary A. Young is assigned as a program analyst with the Management and Evaluation Division, Directorate of Plans and Programs. He holds a BA degree in history and an MA degree in education from Oregon University.

He was a student in the Italian Studies Program at the University of Pavia, Italy, and while in the University of Oregon Honors College was named to the President's Honor Roll.

Emphasis on Excellence . . .

Colonels' Promotion List Recognizes R&D Program

Twenty-five of about 800 members of the Army Research and Development Officer Program, designed to develop a group of highly skilled career officers for the conduct of R&D programs, are on the newest list of selectees for temporary promotion to colonel.

Department of the Army Circular 624-15 lists those selected for promotion. DA Message, DAPO-OPD-CP lists program members selected for FY 1973 attendance at the Senior Service colleges. The estimated period to exhaust the new list is approximately one year after promotions begin.

Under the heading of "Promotion List Accents Value of R&D Program," the *Army Research and Development Newsmagazine* reported recently on the success of R&D Officer Program members in qualifying among selectees for promotion to lieutenant colonel.

Similarly, the latest list shows that the selection rate for program members favorably considered for promotion to colonel the first time they became eligible is considerably higher than the Army average—66 percent as compared to 48 percent.

Selected from the secondary zone (promotion earlier than normally eligible) is LTC Frank J. Palermo, Field Artillery (FA), Office of the Chief of Research and Development, HQ Department of the Army.

Primary Zone R&D program selectees are: LTC James F. Bleecker, FA, 42d Field Artillery Group, APO New York; LTC Thomas Burkhalter, Quartermaster (QM), U.S. Army Inventory Control Group, APO San Francisco; LTC Jack F. Calvert, Chemical Corps (CM), Office of the Assistant Chief of Staff for Force Development.

Also, LTC Frank A. Carter, Signal Corps (SC), U.S. Army Project Modern Army Selected Systems Test, Evaluation and Review Organization, Fort Hood, Tex.; LTC Robert J. Cottey, Intelligence Corps (IN), Army War College; LTC Guy M. Lubold, Ordnance Corps (OD), HQ, U.S. Army Vietnam, APO San Francisco; and

LTC Daniel L. Lycan, Corps of Engineers (CE), 84th Engineer Bn. (Construction), APO, San Francisco 96349; LTC Vincent J. Oddi Jr., IN, U.S. Army Small Arms Systems Agency, Aberdeen Proving Ground, Md.; LTC Walter G. Parks, Air Defense (AD), Office, Secretary of Defense; LTC Castel L. Pittman, CM, Office of Personnel Operations; LTC John H. Reeve, AD, Army War College; and

LTC Everett D. Richards, SC, Avionics Laboratory, Electronics Command, Fort Monmouth, N.J.; LTC Robert L. Russel, AD, U.S. Army Safeguard Systems Office, Arlington, Va.; LTC Robert W. Specker, OD, Deputy Chief of Staff for Logistics; LTC Cecil R. Sykes, FA, Office, Chief of Staff, Army;

LTC Joseph T. Tambe, QM, U.S. Army Quartermaster School, Fort Lee, Va.; LTC Eugene J. Vitetta, SC, Industrial College of the Armed Forces; LTC Leland A. Wilson, FA, Army War College; LTC Roy J. Young, IN, Army War College; LTC Robert F. Daly, AD, OCRD; LTC Gerald G. Gibbs Jr., FA,

OCRD; LTC William F. Reilly, CE, OCRD.

The second announcement, DA Message, DAPO-OPD-CP, concerned the selection of U.S. Army Officers for attendance at the FY 73 Senior Service College Level Schools. There were 14 R&D Program officers selected for the various schools.

Selectees and the schools are: *Army War College*, LTC Jack Apperson, OD, Office of Personnel Operations, LTC Rufus E. Lester Jr., QM, U.S. Army Vietnam, APO San Francisco, and LTC Malcolm V. Meekison, OD, U.S. Army Safeguard Systems Command, Huntsville, Ala.; *Air War College*, LTC William R. Svirsky, SC, Fort Riley, Kans.; *Industrial College of the Armed Forces*, LTC William E. Dismore, CM, Rocky Mt. Arsenal, Colo. LTC Lee M. Hand, SC, Fort Riley, Kans., LTC John W. Hudachek, Armor, U.S. Army Pacific, APO San Francisco, LTC Harold E. Stubbs, OD, U.S. Army Safeguard Systems Command, Redstone Arsenal, Ala., LTC Adalbert E. Toepel, FA, Office, Assistant Vice Chief of Staff, and LTC John J. Top, FA, OCRD; *National War College*, LTC Ronald E. Philipp, OD, OCRD; *Naval War College*, LTC John T. Miller, CE, Fort Bragg, N.C.

Selected for both temporary promotion to colonel and for attendance at the Industrial College of the Armed Forces are LTC Josef F. Senna, QM, Deputy Chief of Staff for Logistics, and LTC Ralph H. Siever Jr., CE, Defense Nuclear Agency.

ALMC Offers Management Course To Reserve Officer R&D Designees

Reserve Officers who are R&D mobilization designees are now eligible for the Research and Development Management Course at the U.S. Army Logistics Management Center (ALMC), Fort Lee, Va.

Tentatively scheduled for June 26 through July 7, the 2-week course will be offered by the Research, Development Test and Evaluation Department of the School of Acquisition Management. This is a major educational activity of the U.S. Army Materiel Command.

Class enrollment will be about 35 students, with a possibility of scheduling a second class Aug. 7-18 based on initial student response.

The purpose of the course is to give special training to officers assigned to the Army's research and development program by presenting important elements involved in the Army's materiel development management efforts.

Primary emphasis will cover the Department of the Army organization and the mission each agency serves in the over-all basic research and materiel engineering design, test, evaluation, procurement and distribution to users activities. Agencies which establish objectives and provide policy, procedures and guidance at the Department of Defense level also will be studied.

Further information may be obtained from LTC George M. Johnson by calling AUTO-VON 687-2509 or 687-5486.

Conferences & Symposia . . .

STRATCOM Conferees Consider Progress In Telecommunications Automation Program

Long-range research and development plans for communications-electronics (C-E) were considered during the recent eighth annual Strategic Communications Command (STRATCOM) commanders conference at Fort Huachuca, Ariz.

Notable was the discussion of the Army Telecommunications Automation Program (ATCAP), designed to provide a system for transmitting voice, message and audio-visual traffic over a single network.

Speaking about ATCAP, scheduled for completion about 1980, COL John D. Nacy, STRATCOM's assistant chief of staff for Force Development, said technological advances in the C-E field will be incorporated into hardware supporting the system.

The equipment being studied for use in ATCAP includes computer-actuated information transmission exchanges, microfilm processing, and interface and remote subscriber components. The network will give the Defense Communications System (DCS) an annual 400 million written message capability in five years.

Conferees were told that the second phase of ATCAP addresses technical concepts and management approaches to satisfy secure voice, record traffic, data, management information systems and audio-visual requirements projected for the late 1970s and beyond.

Forerunners of ATCAP are located at the Army Pentagon Telecommunications Center (PTC), operated by STRATCOM's National Communications Command, and the Telecommunications Center, HQ U.S. Army Pacific Fort Shafter, Hawaii, operated by STRATCOM-Pacific.

The backbone of the system is AUTODIN (automatic digital network). Linking the Pentagon to the global Army commands are 11 overseas and 9 stateside AUTODIN switches operated by the Military Departments under the direction of the Defense Communications Agency (DCA).

Other important C-E topics were discussed. When the conference ended, MG Jack A. Albright, STRATCOM CG, said a unified concept of objectives for the worldwide command had emerged.

The need to modernize and automate communications-electronics, he explained, is closely tied to the current force reductions announced by the Department of the Army, adding: "We are planning today to meet expected personnel losses with a combination of command-developed management techniques and greater use of automation."

During the 4-day conference, more than 20 awards for cost reduction, safety and suggestions were presented to STRATCOM elements.

In special ceremonies, MG Albright was presented the Army's highest award for safety by MG George E. Pickett, Army assistant

STRATCOM Commander MG Jack A. Albright (right) accepts Army FY 71 Award of Honor for Safety. Army Assistant Chief of Staff for C-E MG George E. Pickett presented the award to STRATCOM on behalf of Army Chief of Staff GEN Westmoreland.



chief of staff for communications-electronics, on behalf of the Army Chief of Staff.

STRATCOM was also commended by the Department of the Army for exceeding its cost reduction goal of \$10.3 million by 40 percent in FY 71.

An award for contributing the most under the Army resources conservation program for FY 71 was presented to the Communications Electronics Engineering Installation Agency (CEEIA), which had a validated savings of

nearly \$4 million.

Second place honors for cost reduction went to STRATCOM-Pacific, which reported a savings of \$3.6 million.

Safety awards for FY 71 were presented to these six subordinate commands: 1st Signal Brigade in Southeast Asia, National Communications Command, 11th Signal Group, STRATCOM-Europe, Communications Agency-MTMTS, and the Inter-agency Communications Agency (ICA).

ASAP Meet Focuses on Progress of MVA

Stressed in orientation briefings and discussions during the Army Scientific Advisory Panel meeting Feb. 7-8 at Fort Lewis, Wash., were matters relating to the Modern Volunteer Army (MVA).

Fort Lewis is currently conducting extensive tests to determine the preferences of soldiers for food served in Army messhalls, in line with the Centralized Army Feeding System.

MVA training, individual clothing and equipment, leadership qualities required under this new concept, and other aspects of maintaining standards of military professionalism were discussed at the meeting.

ASAP members toured Fort Lewis facilities, visited troop units, talked and shared meals with soldiers engaged in a broad spectrum of military activities, and observed training and maintenance procedures.

Principal briefings were conducted by MG John D. McLaughlin, CG and commandant of the Quartermaster School at Fort Lee, Va., BG Henry E. Emerson, CG, John F. Kennedy Center for Military Assistance; and BG Paul F. Gorman, assistant commandant of the Infantry School.

Banquet speaker MG Robert J. Seitz, Assistant Deputy Chief of Staff for Personnel (DCSPER), presented his views on the impact of force reduction on the MVA and the quality of leadership.

ASAP Chairman Lawrence H. O'Neill welcomed four consultants to their first ASAP

meeting. They are Dr. Meredith P. Crawford, president of the Human Resources Research Organization (HumRRO); Daniel J. Fink, vice president and general manager, Space Division, General Electric Co.; Dr. Ralph Siu, private consultant; and Dr. Kenneth M. Sowers, president, Florida Episcopal College.

Dignitaries in attendance, in addition to 24 panel members and consultants, included Assistant Secretary of the Army (R&D) Robert L. Johnson; GEN Henry A. Miley Jr., CG of the Army Materiel Command; LTG William C. Gribble Jr., Army Chief of Research and Development; MG Curtis W. Chapman, deputy CG, Combat Developments Command; Dr. Marvin E. Lasser, Army Chief Scientist; MG E. P. Smith, deputy Assistant Chief of Staff for Force Development (ACSFOR); Dr. Alexander L. Slafkosky, scientific adviser to the Deputy Chief of Staff for Research and Development, HQ USMC; and LTG Austin W. Betts (USA, Ret.), former Army Chief of Research and Development.

Publication Outlines EPA Statutes

A 2-volume manual of statutes and executive orders governing the U.S. Environmental Protection Agency (EPA) has been published.

Titled "EPA Current Laws," the manual provides all of the laws pertaining to the year-old EPA that are scattered throughout the United States Code.

Copies are available through the U.S. Government Printing Office, Washington, D.C.

Army Science Conference Participation Expands

Innovations highlighting the U.S. Army Science Conference June 21-23 at the United States Military Academy, West Point, N.Y., will include participation of high-ranking defense officials of France and the Federal Republic of Germany.

As members of the Quadripartite Agreement for standardization of weapons and military tactics in their deployment, the United Kingdom, Canada and Australia have joined for more than a decade with the United States in sending top-level defense officials concerned with research and development activities to the U.S. Army Science Conference.

U.S. Army Chief of Research and Development LTG William C. Gribble Jr. has accepted the Army Science Conference Advisory Group's invitation to present the keynote address. Representatives of the five foreign nations also will present papers on R&D trends.

Deputy and Scientific Director of

Army Research Dr. Richard A. Weiss heads the group, as he has since the inception of the biennial meeting in 1957. The banquet speaker is unannounced.

Popularity of the panel discussion at the past three conferences has been recognized by the advisory group's decision to continue this feature at the 1972 meeting. Jack I. Hope, technical assistant to the Director of the Office of Science and Technology, Executive Office of the President, has accepted an invitation to chair the panel. The theme is "Reliability, Availability and Maintainability" as applied to military materiel.

Membership of the panel had not been decided as the *Army Research and Development Newsmagazine* went to press. In previous years it has consisted of nine members representative of the Department of Defense, industrial organizations engaged in defense R&D, academic institutions and the general public.

Cash honorariums totaling \$3,500 to

\$4,000, provided through the U.S. Army Incentives Awards Program, the top award of the Dr. Paul A. Siple silver medallion, and Certificates of Achievement signed by the Assistant Secretary of the Army (R&D) Robert L. Johnson and General Gribble will be presented to authors of outstanding presentations among 100 technical papers.

Seven exhibits depicting notable recent achievements in Army medical science will be shown by the Medical Research and Development Command.

Project officers for the conference are LTC William T. King, Research Technology Division, Office of the Chief of Research and Development, who also is executive secretary of the Army Science Conference Advisory Group, and LTC Jack Jeter, representing the U.S. Military Academy as host.

NATO Panel Sponsoring Reliability Testing Meet

The NATO Advisory Panel on Operations Research will sponsor a conference on Reliability Testing and Evaluation in The Hague, Netherlands, Sept. 4-8.

Presentations and discussion will cover such aspects of operations research as confidence bounds for system reliability, military demonstration techniques and requirements, and cost effectiveness and allocation of resources in testing.

Other areas of interest include reliability of computer software and software for checking the reliability of complex equipment; overstress testing and accelerated life testing; and exploitation of

knowledge of relevant physical processes in modeling stochastic phenomena.

Authors of papers have been selected and attendance at the conference will be limited. Persons desiring to participate, but not present a paper, should notify Dr. Nancy R. Mann, Rocketdyne, North American Rockwell Corp., 6633 Canoga Ave., Canoga Park, Calif. 91304.

Astronaut Picked as Keynoter For National JSH Symposium

Astronaut Russell Schweikart of the NASA Manned Spacecraft Center has accepted an invitation to give the keynote address at the Tenth Annual National Junior Science and Humanities Symposium, Apr. 27-29.

That presentation will be followed by a special program by the Morehead Planetarium, tours of laboratories of 11 North Carolina companies in the Durham area, an after-dinner address by Dr. Guy Owen, North Carolina State University professor who authored The Flim Flam Man, and a dance—all on Apr. 27.

Under the auspices of the Chief of Research and Development, Department of the Army, the U.S. Army Research Office-Durham (ARO-D) will be host to the gathering of some 175 students selected from 29 regional JSHS.

Programed for the featured "Science Address" is Dr. Carey H. Bostian, professor of genetics at North Carolina State University. His presentation will be followed by tours of laboratories at University of North Carolina, Duke University, and N.C. State University.

Other highlights will include a banquet address by Robert F. Rines, president, The Academy of Applied Science, Belmont, Mass., and the "Humanities Address" by Dr. Bernard Boyd, University of North Carolina.

The innovation at the 1971 National JSHS of having 30 selected students present technical papers (their basis for selection) will be continued in five concurrent sessions.

SCIENTIFIC CALENDAR

Scintillation and Semiconductor Counter Symposium, sponsored by IEEE, Washington, D.C., Mar. 1-3.

1972 Western Metal and Tool Exposition and Conference, sponsored by ASM and SME, Los Angeles, Calif., Mar. 13-17.

Physical Electronics Meeting, Los Alamos, N. Mex., Mar. 20-22.

International Convention of the Institute of Electrical and Electronics Engineers, N.Y.C., Mar. 20-23.

Accuracy in Spectrophotometry and Luminescence Measurements Conference, sponsored by NBS, Gaithersburg, Md., Mar. 22-24.

Conference on Man's Role in Space for Reliability and Maintainability, sponsored by AIAA, Cocoa Beach, Fla., Mar. 27-28.

12th Symposium on the Engineering Aspects of Magnetohydrodynamics, Argonne, Ill., Mar. 27-29.

Annual International Symposium on Computer-Communications Networks and Teletraffic, sponsored by PIB-MRI, N.Y.C., Apr. 4-6.

1972 Reliability Physics Symposium, sponsored by IEEE and NASA, Las Vegas, Nev., Apr. 5-7.

4th Annual International Geoscience Electronics Meeting, sponsored by IEEE, Washington, D.C., Apr. 9-14.

13th Structures, Structural Dynamics and Materials Conference, sponsored by AIAA, ASME and SAE, San Antonio, Tex., Apr. 10-14.

Stabilized Fragment Review Conference, sponsored by AMC, Navy and AF, Dover, N.J., Apr. 4.

Astronomical Techniques for Atmospheric Determination, sponsored by AAS and University of Washington, Seattle, Wash., Apr. 13.

International Conference on Inner Shell Ionization Phenomena, sponsored by ARO-D, AEC, NSF, NASA, Moffett Field, International Union of Pure and Applied Physics and International Union of Pure and Applied Chemistry, Atlanta, Ga., Apr. 17-21.

26th Annual Spring Meeting of Research and Development Associates for Military Food and Packaging Systems, Rosemont, Ill., Apr. 18-20.

International Quantum Electronics Conference, sponsored by IEEE, Montreal, Canada, May 7-11.

Meeting of the Electrochemical Society, Dallas, Tex., May 7-12.

20th Annual Meeting of the Radiation Research Society, Portland, Ore., May 14-18.

11th U.S. Army Operations Research Symposium, sponsored by ARO-D, Durham, N.C., May 16-18.

2d International Conference on Vapor Growth and Epitaxy, sponsored by ARO-E and Hebrew University of Jerusalem, Jerusalem, Israel, May 23-25.

25th Power Sources Symposium, sponsored by AMC, Atlantic City, N.J., May 23-25.

18th Conference of Army Mathematicians, sponsored by ARO-D and MSC, Dover, N.J., May 24-26.

JSEP Announces Program Of Meetings During 1972

The Joint Services Electronics Program (JSEP) has announced its calendar for 1972.

Organized in 1946, the JSEP is conducted through representatives of the Army, Navy and Air Force scientific community and academic personnel of various universities interested in cooperative electronics R&D efforts.

Scheduled programs include: Electronics Research Center, University of Texas at Austin, Mar. 15-16. Research Laboratory of Electronics, Massachusetts Institute of Technology, May 8-9. Division of Engineering and Applied Physics, Harvard University, May 10-11. Stanford Electronics Laboratory, Stanford University, Aug. 9-10. Coordinated Science Laboratory, University of Illinois, Oct. 17-18. Microwave Research Institute, Polytechnic Institute of Brooklyn, Dec. 5-6. Columbia University Radiation Laboratory, Dec. 7-8.

Personnel Actions . . .

Pierce Commands APG Ordnance Center, School Following Ostrom's Retirement From Service

The new commanding general of the U.S. Army Ordnance Center and School, Aberdeen Proving Ground (APG), Md., is BG John R. Pierce Jr. whose career as an Army officer began there on Dec. 23, 1944 when he was commissioned a second lieutenant.

BG Pierce brings to this key position 28 years of military experience, much of it in the logistical field. He succeeded BG Charles D. Y. Ostrom Jr., former Director of Army Research, upon his recent retirement from military service.

Before coming to APG, he served in Europe for three years, first as commander, U.S. Army Ammunition Depot, then as CO of the Kaiserslautern Army Depot, and finally as the deputy CG for Area Support, Theater Army Support Command, U.S. Army Europe.



BG John R. Pierce Jr.

A career logistician, BG Pierce commanded the 80th General Support Group in Da Nang, Republic of Vietnam from July 1967 to July 1968, following duty in Washington, D.C., as special assistant to the Secretary of the Army for resources management.

A graduate of the Babson Institute of Business, Babson Park, Mass., where he earned a

27-Year Army-Industry Career Peaks at AVSCOM

Establishment of the first supergrade GS-16 position within HQ U.S. Army Aviation Systems Command (AVSCOM), St. Louis, Mo., with Richard L. Long recruited from industry as the first incumbent, has been announced.

Long has more than 27 years experience in the aerospace field in industry and with the U.S. Government. He retired from the Army as a full colonel in 1965.

In recent years he has served with the firm as assistant chief of advanced research engineering and, later, as senior project engineer for advanced projects. He was national president of the Army Aviation Association of America in 1969-70.

During his military career, which began in 1942, he served in World War II in Europe as an observation pilot, squadron commander, and Army liaison officer to the Air Force Engineering Division at Wright-Patterson (Ohio) AFB. He was chief, Airborne and Army Aviation Branch, Office of the Chief of Research and Development, Department of the Army, 1952-55.

Subsequently he served as military assistant to the Director of Aeronautics, Office of the Director of Defense Research and Engineering, providing technical advice on R&D

BS in business administration, BG Pierce has attended the Ordnance School, the Command and General Staff College, and the Army War College.

His medals and awards include the Legion of Merit with two Oak Leaf Clusters, Air Medal with Oak Leaf Cluster, and the Army Commendation Medal.

programs for helicopters, V/STOL and tactical transport aircraft.

Long has written and published technical papers on Army aircraft and aerospace subjects, is a Master Army Aviator, and is rated as a commercial pilot for fixed- and rotary-wing aircraft.



Richard L. Long

MICOM Increasing Overall Capabilities of Redeye Missile

Announced by HQ U.S. Army Missile Command is a project to build on the capabilities of the Redeye ground-to-air missile in order to produce a Redeye II that will be fired from the shoulder and will fly faster and farther than the old Redeye.

A high-performance propulsion system for the new missile and an advanced infrared guidance technique have been developed and flight tested. Additional capabilities that may be built into Redeye II will include a night sight and a device to identify aircraft.

General Dynamics, Pomona, Calif., has been requested to supply a proposal for engineering development.

This is the fifth project-managed missile system under direction of the Army Missile Command. Named as manager is COL David H. Souser who came from Fort Bliss, Tex., where he was commanding officer of the 15th Air Defense Group.

Recognized as an experienced air defense officer, he is a graduate of Duquesne University with a BS degree in education and has a master's degree from Syracuse University.

H. Hoyt Harris, a civilian who directed Redeye II through earlier research and development, will be deputy project manager.



COL David H. Souser

Included in his academic qualifications are a BS degree in aeronautical engineering from Purdue University, a master's in engineering from Princeton University, and a master's in international affairs from George Washington University.

His current responsibilities involve engineering programs carried out by more than 800 AVSCOM civilian and military personnel. He coordinates aviation-oriented programs for avionics, weaponization and human engineering of Army aircraft, including coordination of funding requirements for Army Materiel Command project managers as necessary.

Baize Becomes EPA Legislation Head

Administrator of the U.S. Environmental Protection Agency William D. Ruckelshaus has announced the appointment of Gary H. Baize as director, Office of Legislation.

Baize has been assistant to Ruckelshaus since the inception of EPA 13 months ago and was his legislative assistant when the EPA administrator served as majority leader in the Indiana General Assembly.

Rechtin Named First SecDef for Telecommunications

Appointment of former Principal Deputy Director of Defense Research and Engineering Dr. Eberhardt Rechtin to a newly created position of Assistant Secretary of Defense for Telecommunications has been announced by Secretary of Defense Melvin R. Laird.

Establishment of this position—one of the recommendations of the 1970 recommendations of President Nixon's Blue Ribbon Panel appointed to study reorganization of the Department of Defense—increases to nine the number of Assistant Secretaries of Defense.

Department of Defense Directive 5135.1, dated Jan. 11, 1972, upgrades the new position from Assistant to the Secretary of Defense for Telecommunications. President Nixon signed Public Law 92-215 on Dec. 22, 1971, authorizing the change.

Dr. Rechtin will be the principal staff assistant to Secretary Laird on telecommunications, including the National Communications System, the World-Wide Military Command and Control System and the National Military Command System.

The Department of Defense telecommunications function exceeds the size and scope of many commercial communications organizations in capital investment, number of personnel and worldwide operation.

COL Sisson Assumes Dual Posts At Edgewood Arsenal Directorate

COL George D. Sisson Jr. has been named director of the Manufacturing Technology Directorate, Edgewood Arsenal, Md., where he will also direct Project Eagle, the demilitarization of obsolete chemical agents and munitions stored at Rocky Mountain Arsenal, Denver, Colo.

He recently completed a tour of duty as chief, Operations Division, HQ U.S. Army, Long Binh, Vietnam, and has served in Korea, Germany, Pine Bluff Arsenal, Ark., and an earlier tour of duty at Edgewood Arsenal. He graduated from the Command and General Staff College, Fort Leavenworth, Kans., prior to an assignment as chief of the Academic Operations and Management Logistics Division at the Chemical School, Fort McClellan, Ala.



COL George D. Sisson Jr.

Secretary Laird has said that top management of communications, particularly in the area of command and control, is essential and critical.

Dr. Rechtin had served as Principal Deputy Director of Defense Research and Engineering since December 1970. He served previously as Director of the Advanced Research Projects Agency (ARPA).

Dr. Rechtin formerly was assistant director of the Jet Propulsion Laboratory, California Institute of Technology, where he received a BS degree in 1946 and a PhD degree (cum laude) in 1950.



Dr. Eberhardt Rechtin

Mittenthal Succeeds Lynch as ARO-D Commander

Following service as special assistant to the Director of Army Research since September, COL Lothrop Mittenthal has assumed command of the Army Research office, Durham, N.C. (ARO-D).

COL William J. Lynch, who had commanded ARO-D since July 1970, retired Feb. 29 after more than 30 years active duty. Until assigned to ARO-D, he was Assistant Director of Army Research and commander of the Army Research Office in Washington, D.C., for almost three years. Prior to an assign-



COL Lothrop Mittenthal

ment as chief of the Technical Industrial Liaison Office, Office of the Chief of R&D, Department of the Army, he was deputy chief of staff, U.S. Army, Hawaii, for a 3-year tour (1964-67).

COL MITTENTHAL has served since 1969 as chief, Cost Analysis Division, Comptroller, HQ Army Materiel Command, and chief, Weapons and Systems Division, Air Defense Directorate, Office of the Assistant Chief of Staff for Force Development.

During 1969, he was military assistant to the Assistant Deputy Director (Defensive Systems), Office, Director of Defense Research and Engineering.

From 1966 to 1969, he was deputy commanding officer, U.S. Army Research and Development Group, Europe, at Frankfurt, Germany. That tour followed graduate study at the University of California, Los Angeles (UCLA) culminating with a PhD in mathematics.

He has an MS degree in mathematics from UCLA, a master's in physics from the University of Southern California (1953), and a BS degree in applied physics from California Institute of Technology (1948). In 1963 he completed the U.S. Army Command and General Staff College course.

Thomas Follows Harris as Deputy Commander of WECOM

Retirement of COL James F. Harris Jr. has made COL Raymond P. Thomas his successor as deputy commander, Army Weapons Command, headquartered at Rock Island, Ill. COL Thomas served until recently for 22 months as deputy assistant chief of staff (G-4), Ismir, Turkey, NATO.

Graduated from the University of Maine in 1942 with a BS degree in mechanical engineering, he accepted an ROTC commission and entered active duty with the U.S. Army, serving in the European Theater of Operations during World War II. He served in Korea during the Korean conflict.

His military schooling includes graduation from the U.S. Army Ordnance School, Command and General Staff College, and the NATO Defense College. Among his military honors are the Meritorious Service Medal, Bronze Star and the Army Commendation Medal.

(Personnel Actions Continued on p. 48)



COL Raymond P. Thomas

Awards . . .

Gun Improvements Save \$4 Million

Benet Weapons Laboratory Director Dr. Robert E. Weigle (right) presents Cost Reduction plaque to Paul K. Rummel, chief of the Watervliet Arsenal Development Engineering Directorate.



Improvements increasing the safe service life of components of the 175mm self-propelled gun, resulting in estimated savings of \$4,101,500, recently earned cost-reduction plaques for six Watervliet (N.Y.) Arsenal engineers, the U.S. Army Materiel Command has announced.

Paul K. Rummel, chief of the arsenal's Development Engineering Directorate, instituted a program of testing 175mm gun tubes under combat conditions in Vietnam. Resulting changes increased safe life expectancy of the tubes from 700 to 1,200 rounds for estimated savings of \$2,899,700.

AMC cost-reduction plaques were also presented to five members of the Benet Weapons Laboratory staff who conducted tests on the breech mechanism of the 175mm weapon. The breech life was increased from 1,600 to 3,600 rounds thereby saving \$1,201,800.

They are mechanical engineers Miles E. Kraut, Ralph R. Lasselle, Donald G. Forkas and Maurice E. Scavullo and Burton J. Carman, an engineering technician.

Rummel's program carried out at five artillery fire bases in central Vietnam was monitored under combat conditions by civilian teams from the U.S. Army Weapons Command.

CRREL Hydrologist's Ice Studies Win Straub International Award for 1971

Dr. George D. Ashton, U.S. Army Cold Regions Research and Engineering Laboratory, has been named the recipient of the international Lorenz G. Straub Award for 1971.

Established under the Lorenz G. Straub Memorial Fund, St. Anthony Falls Hydraulic Laboratory, University of Minnesota, the award is given annually for the most meritorious doctoral thesis in hydraulic engineering.

Presentation of the gold medal and a cash honorarium is scheduled Apr. 6 at the University of Minnesota where Dr. Ashton will speak at a colloquium, basing his talk on his thesis "Formation of Ice Ripples on the Underside of River Ice Covers."

Dr. Ashton was recently named corecipient of the Prize for Excellence for his thesis by the Institute of Hydraulic Research, University of Iowa.

He received his doctorate in 1971 from the University of Iowa as a J. Waldo Smith Fellow.

As a hydrologist at USACRREL, his principal work is on the formation of relief patterns on the underside of river ice covers and their effects on hydraulic roughness and heat transfer characteristics of ice covers, mechanics of formation of ice jams, and ice cover breakup processes and phenomena.



Dr. George D. Ashton

MERITORIOUS CIVILIAN SERVICE. *Hilbert E. Friend* recently received the Army's second highest civilian honorary award, the Meritorious Civilian Service Award (MCSA), based on achievements prior to his retirement in 1971 as chief, Research Contracts and Grants Branch, Research Programs Office, Army Research Office, Office of the Chief of Research and Development.

Chief of R&D LTG William C. Gribble Jr. made the presentation. The citation acclaimed Friend for more than a decade of continuing outstanding performance with the Army Research Office.

R&D contributions to the national ballistic missile defense program over a 3-year period have earned *Robert A. Norling* and *Dr. Ralph H. Pennington* the Department of the Army Decoration for Meritorious Civilian Service.

Dr. Jacob B. Gilstein, Deputy Assistant Secretary for R&D (BMD) and director of the U.S. Army Ballistic Missile Defense Agency (ABMDA), presented the awards. Norling was cited as ABMDA director, Hardsite Defense Program. He is now director of an optical technology group with Honeywell, Inc.

Known nationally for his work in optical systems, Norling was initially recruited by ABMDA to define and institute investigations of the feasibility of warhead discrimination and tracking by this technique; also, to manage the ensuing development, test and evaluation programs.

The citation accompanying the award credits him with developing a firm basis for the successful use of optical technology in defeating a highly sophisticated ballistic missile attack on the nation.

DR. PENNINGTON, a U.S. Military Academy graduate, joined the ABMDA staff in 1968, following retirement from the Air Force. He supervised implementation of a series of programs directed toward identifying and solving problems associated with the design, development, evaluation and production of total system software.

His work was related to large-scale, real-time digital computers that may be used in advanced ballistic missile defense systems.

During 22 years of work with the Army and Air Force on nuclear weapons design and effects calculations, he was recognized for development of employment concepts, stockpile requirements, operational command and control doctrine, and computational support of tests.

Dr. Pennington was a member of Project Matterhorn, a group of scientists who performed calculations relating to feasibility and design of the first hydrogen bomb. He was recognized also for helping to develop the most powerful scientific computation system within the Department of Defense for the Air Force Laboratory at Kirtland Air Force Base, N. Mex.

In 1966, while he was still a colonel in the Air Force, he received the Atomic Energy Commission's Ernest Orlando Lawrence Memorial Award. He is presently employed by System Development Corp., Hendersonville, N.C.

OUTSTANDING CIVILIAN SERVICE. *Richard R. Entwistle*, director of the Engineering Design Handbook Office of Duke University, Durham, N.C., recently received the Department of Army Outstanding Civilian Service Award. He was cited for notable contributions to the improved management of the Army Materiel Command's Engineering Design Handbook Program.

GEN Henry A. Miley Jr., commanding general of the Army Materiel Command, presented the award in Washington, D.C.

DISTINGUISHED SERVICE MEDAL. *COL Katherine E. Manchester* recently received the nation's highest award for meritorious performance of military duty, the Distinguished Service Medal. She was honored upon her retirement from more than 31 years active service as an Army dietician.

Chief of the Food Service Division of Walter Reed General Hospital since 1964, she was presented the award by BG William H. Meroney, commanding general of the hospital.

LEGION OF MERIT. *COL Preston B. Canady* received the third Oak Leaf Cluster (OLC) to the Legion of Merit (LM) at his recent retirement ceremony at Redstone Arsenal, Ala. He was cited for notable contributions to the conduct of missile development programs.

LTC Mark Bonham Jr., chief of the U.S. Army Computer Systems Command's Tactical Systems Design Group, Fort Monmouth, N.J., has been awarded the first OLC to the LM in recognition of his outstanding service during 1970-71. During this period he was assistant chief of staff for personnel, U.S. Army Support Command, Da Nang, in the Republic of Vietnam.

NAVY CROSS. An Army Medical Service Corps pilot from Michigan recently received the Navy's highest decoration, the Navy Cross, for his valor in the rescue of downed Navy airmen. He is the first

Army member to receive this distinction in the Vietnam War.

In September 1970, while he was piloting an Army medical evacuation helicopter, **CAPT Kenneth Ledford Jr.** came under heavy fire as he attempted to pick up six wounded soldiers from a clearing. Forced to leave the area temporarily, he returned with the support of four armed Navy helicopters, two of which were shot down and two heavily damaged by intense enemy fire during the rescue attempt. Crewmen of both the downed aircraft were rescued.

BRONZE STAR MEDAL. **MAJ Robert A. Burns** recently received the 2d and 3d OLC to the Bronze Star Medal (BSM). Army Chief of R&D LTG William C. Gribble Jr. made the presentation.

MAJ James F. Turner was awarded the first OLC to the BSM in a recent ceremony at the Pentagon. The award was presented by Chief of R&D LTG William C. Gribble Jr.

MERITORIOUS SERVICE MEDAL. COL Hunter G. Taft Jr., MSC, commanding officer of the U.S. Army Environmental Hygiene Agency at Edgewood Arsenal, Md., recently received the first OLC to the Meritorious Service Medal (MSM).

The award was made in recognition of 1967-71 outstanding service at Brooke Army Medical Center, Fort Sam Houston, Tex., as chief, Environmental Engineering Branch, Department of Preventive Medicine, Medical Field Service School.

LTC John Cook has been awarded the MSM with MG George Sammet Jr., Deputy Chief of Research and Development, making the presentation in a ceremony at the Pentagon.

MAJ Eugene H. Caylor received the MSM for distinguished service during his duty as project officer for the U.S. Army Computer Systems Command (CSC) Personnel and Force Accounting Directorate.

ARMY COMMENDATION MEDAL. **CAPT William J. Chantelau** was recently awarded the second OLC to the Army Commendation Medal (ARCOM) in recognition of his service as chief of Operations, Personnel and Force Accounting Data Systems Directorate, CSC.

CWO Joe C. Quick recently received the ARCOM for meritorious service as plant superintendent of the Army's MH-1A floating nuclear power plant, "Sturgis" located in Gatun Lake, Canal Zone, during 1970-71. The award ceremony took place at Fort Belvoir, Va.

MASTER ARMY AVIATOR'S BADGE. **LTC Edwin M. Aguanno**, chief of the Air Movement Branch, Developments Directorate, OCRD, is a recent recipient of the Master Army Aviator's Badge. BG Robert J. Baer, Director of Developments, presented the award.

MISCELLANEOUS AWARDS. SSG Russell E. Carpenter received cash awards totaling \$535 for three suggestions which it is estimated will save the Army more than \$8,000. When Carpenter made the suggestions he was in radar maintenance with the Industrial Operations Directorate, HQ Fort Huachuca, Ariz.

Walter Garthe, Elias Ghazi, George Hyde and Manhart Cankes received Army Materiel Command (AMC) Cost Reduction Awards for an idea which it is estimated has saved AMC nearly \$605,000. Cankes has retired and the others are employed by the Ammunition Development and Engineering Directorate of Picatinny Arsenal.

James R. Bryant of the U.S. Army Mobility Equipment Research and Development Center recently received an AMC Commendation Plaque for his contributions to the center's Resources Conservation Program during FY 70. The citation credits him with a saving of \$607,800 on the procurement of tractors.

E. H. Adams of the Primary Standardization Office, International Division of the Directorate of Plans and Programs, OCRD, recently received an official commendation for his role in the update of the American, British, Canadian, Australian Operational Concept, 1981-1990.

The Letter of Commendation was issued by Richard A. Weiss, Deputy and Scientific Director of Army Research, and chairman of the Quadripartite Research Committee (QRC). Adams serves as secretary of the QRC in addition to his regular duties.

Women's Army Corps' Ire Raised

Acronyms are often a bane to editors, particularly in the pressure of "deadline" time constraints for the printer. In no other way can we try to explain the "whooper of a boner" that rightfully stirred the ire of Women's Army Corps readers of our January-February edition.

Somehow, WAC was identified as the Women's Auxiliary Corps. Strangely, no one in the long review process, including numerous copy-readers and proofreaders, caught that error in a page 1 article announcing that MAJ Marie D. Ramirez became the first WAC to qualify for the highly selective Army R&D Officer Program.

Our apology goes to MAJ Ramirez and to all other WAC members.

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Bulletin Board

Dunn Reviews 26 DNA Projects at WES



In line with duties as director of the Defense Nuclear Agency (DNA), LTG Carroll H. Dunn (pictured at left) revisited the U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss., in February to review 26 DNA projects.

From 1952 to 1955 he was the director of WES, with which the DNA is funding FY 1972 research and development projects valued at over \$2 million, involving both laboratory and field studies.

Approximately three-fourths of the efforts are in the Nuclear Weapons Effects Division. Major areas of investigation include water shock wave propagation, water wave theory, crater and ejecta, personnel shelter concepts, and evaluation of strategic structures. The program involves high-explosive field tests in Utah and Colorado.

The Soils Division is allotted nearly \$500,000 to study the propagation of ground shock through earth media. Almost as much is being used by the Explosive Excavation Research office, a field office of the Waterways Experiment Station in California, for massive excavations using chemical explosives. The Concrete Division is funded for nearly \$50,000 to develop special shock-absorbing concrete and grouting for instruments.

COL Ernest D. Peixotto (pictured with GEN Dunn), director, and key members of the professional staff presented briefings on the work of the Waterways Experiment Station to General Dunn and members of his party, Dr. John Northrop, Dr. Marvin Atkins, John Lewis, LTC L. Circeo, and MAJ T. J. Kelly, Washington, D.C.

Thin Plate Material Report Published

Results of joint research activity involving factors in thin plate materials were published recently in a paper titled, "Experimental and Analytical Strains in an Edge Cracked Sheet."

David P. Kendall, mechanical engineer, and John H. Underwood, research metallurgist, both from Watervliet Arsenal, N.Y., collaborated with Dr. J. J. Swedlow in authoring the report published in the *Journal of Engineering Fracture Mechanics*. It was presented originally at the Third Annual Symposium on Fracture Mechanics at Lehigh University, Bethlehem, Pa.

Experimental testing in the research task was done by Kendall and Underwood. Dr. Swedlow performed the analytical and computer analysis.

New Lab Facility Opens at Brooke Medical Center

The U.S. Army Institute of Surgical Research Biochemistry Laboratory and conference building at Brooke Army Medical Center, Fort Sam Houston, Tex., was opened recently.

Under construction for about a year, the new facility is part of the large laboratory complex supporting the Army's internationally famous burn study and treatment center.

MG Kenneth D. Orr (pictured cutting ribbon), the medical center commander, and LTC Basil A. Pruitt Jr. (assisting at ribbon cutting), director-commander of the research institute, spoke at the opening ceremonies.

BG Edward H. Vogel Jr., deputy commandant of the U.S. Army Medical Field Service School and former director of the research unit, and BG David E. Thomas, commander of Brooke General Hospital, attended the ceremonies.



People in Perspective . . .

Good Supervisors Can Help . . .

H.S. Graduate Attributes Success to Good Guidance

What heights of achievement can a man scale as an electronics engineer with only a high school education? The obvious answer: That depends on the man—how special he is by way of ambition and talent to succeed.

When Marvin Bernstein retired recently after three decades of service at HQ U.S. Army Electronics Command and its predecessor organizations at Fort Monmouth, N.J., his record provided a more impressive answer—based on notable contributions to ECOM's prestigious reputation.

Graduated from Buffalo (N.Y.) Technical High School, Bernstein completed his 30-year Federal Civil Service career with no further

formal education—not even one of the numerous special courses or Army organized training other than on-the-job help from associates.

Still the record of his career progress credits him with development of: precision glass-enclosed crystal units widely used in single sideband radio sets; a ruggedized crystal unit capable of surviving artillery gun launches; and a series of quartz crystal sets used in the United States and several foreign countries. He also is the holder of two patents assigned to the Army and has a third application pending.

In addition, he has served as chairman of the former international Mallard Project Technical Experts Committee on piezoelectric crystals and ovens. He has presented 12 papers on the subject of frequency control. Eight of his papers have been published in magazines and in proceedings of the Annual Frequency Control Symposium and the International Telemetry Conference.

He has attended 10 meetings of the NATO Special Working Group on Frequency Control in Paris, Brussels and London and was the principal United States member during the past eight years.

Bernstein has been awarded several honors for his published papers and for solving a critical crystal production problem for squad radio sets. He is a 40-year member of the American Radio Relay League.

What does he consider the key to his success? The answer: "I was extremely fortunate in having excellent supervisors who were kind enough to take me under their wing."



Marvin Bernstein

CRREL Physical Scientist Serving on Mariner 9 Data Team

Dr. Duwayne M. Anderson, a supervisory physical scientist at the U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, N.H., is serving as the only Army member of the Mariner 9 Data Analysis Team on the Viking Project.

In 1966 he was awarded a Secretary of Army Research and Study (SARS) Fellowship and studied at the Royal Institute of Technology in Stockholm, Sweden.

Periodically in residence at the Jet Propulsion Laboratory in Pasadena, Calif., the team is responsible for selecting landing sites for the NASA Viking 75 mission, based on analysis of photographs currently being transmitted by the Mariner 9 orbiting capsule.

The Viking 75 mission will land a scientific instrument module on Mars to analyze and measure that planet's atmosphere and surface properties and to perform life-detection experiments.

Dr. Anderson's specific interest is in the analysis of the water content of the Martian soil for the Viking 75 project and he is working with the NASA team in the development of appropriate instrumentation.

Among the photographs recently returned by the Mariner 9 television cameras are several showing terrain analogues to the permafrost terrain in the terrestrial south polar cap. Others also show evidence of the possible existence of water in the Martian surface materials. Dr. Anderson is developing theories of the Martian soil water balance that will be tested during the 1975 Viking mission.

Dr. Anderson received a BS degree in geology in 1954 from Brigham Young University and a PhD in soil chemistry from Purdue University in 1957.



Dr. Duwayne M. Anderson

Horton Assumes Chairmanship Of SAE Powerplant Activity

The Powerplant Activity of the Society of Automotive Engineers (SAE) has elected as its 1973 chairman James H. Horton, U.S. Mobility Equipment Research and Development Center (MERDC), Fort Belvoir, Va.

Ranked as one of the most important units of the SAE, the activity develops, collects, and helps to disseminate to members, technical information pertaining to design, development and performance of powerplants—except those specifically designed for aerospace vehicles, and except spark-ignition piston engines specifically designed for passenger automobiles, trucks or buses.

Horton is chief of the MERDC Electrome-



James H. Horton

chanical Division, Electro-technology Department. Active in the SAE as a member since 1948, he has served as a liaison member of the engine committee; as a consultant to the small industrial and utility engine subcommittee, and as chairman of the gas turbine engine subcommittee.

Horton entered Federal Civil Service in 1940, served in the Navy during World War II, and was employed at the Naval Engineering Experiment Station, Annapolis, Md., until he transferred to the MERDC's predecessor organization in 1948.

He received a BS degree in mechanical engineering from Purdue University in 1939.

Boyes Succeeds Condit at CDC As CG of Logistics Systems Group

BG John H. Boyes, recently promoted to that rank at HQ Combat Developments Command (CDC), Fort Belvoir, Va., has assumed command of the CDC Personnel and Logistics Systems Group at Fort Lee, Va., succeeding BG Ross R. Condit Jr.

In recent assignments he has served as chief of staff, Da Nang Support Command (Provisional), CO, 188th and 73d Maintenance Battalions in Vietnam, and in U.S. as project manager for anti-tank assault weapons.

Reader's Guide . . .

USMA Publishes Soviet Union Atlas

Believed the most complete landscape atlas of the Soviet Union ever made generally available in the United States as a reference work is a new publication prepared by a team of United States Military Academy researchers.

Currently being used by USMA students, the atlas was prepared under a grant from the U.S. Army Research Office-Durham, N.C., a field element of the Office of the Chief of Research and Development.

Landscape of the USSR was coauthored by Majors Thomas F. Plummer Jr., William G. Hanne, Edward F. Bruner and Christian C. Thudium Jr. The director of the Academy environmental faculty provided editorial assistance and general guidance.

Compiled through extensive field trips covering thousands of miles of travel in the USSR, the atlas contains information from diverse Russian Government agencies and advice from experts such as Theodore Shabad, editor of *Soviet Geography: Review and Translation*.

An Army R&D Newsmagazine editor interviewed MAJ Plummer shortly after his return from a 50-day study tour of the Soviet Union in 1967. For further information, see the December 1967 issue, p. 12.

The 70 topographic map sections represent the different major physiographic regions of the USSR. Printed in five colors, the maps are reproduced to the scale of 1:250,000 (one map inch equalling approximately four land miles).

Although the USSR landscape atlas is not classified, the first printing by the U.S. Army Topographic Command is limited to use within courses offered by the USMA's Department of Earth, Space and Graphic Sciences. Limited distribution to interested U.S. Government agencies is planned. Later editions may be published commercially if the Atlas proves of sufficient general interest.



USMA Superintendent LTG William A. Knowlton reviews new Landscape Atlas of the USSR, authored by members of the West Point Earth, Space and Graphic Sciences Department, with one of the coauthors, MAJ Edward F. Bruner, also an instructor.

BESRL Studies Leadership, Computer Techniques

Leadership dimensions and man-computer input technique studies by the U.S. Army Behavior and Systems Research Laboratory,

EM Program Offers Degree, Medical Corps Commission

Young enlisted personnel, male and female, interested in obtaining a bachelor's degree in environmental engineering and commissioned officer status in the U.S. Army Medical Service Corps, are offered an opportunity in a recently announced program.

Announced by the Office of the Surgeon General, the program provides full tuition, fees and reimbursement for books and other expendable supplies plus full pay and allowances appropriate to each enrollee's grade.

Qualified applicants will be selected to attend an 8-week environmental sciences and engineer introductory course beginning June 19 at the U.S. Army Medical Field Service School, Fort Sam Houston, Tex. Graduates will be chosen for the 4-year program based on ability, sincerity and motivation shown in the introductory course.

Applicants must be between the ages of 19 and 26 except that a waiver of the minimum age is possible in exceptional cases. Each acceptable year of college previously completed increases the top age limit by one year.

Qualification requirements include a high school diploma or its equivalent, a good working knowledge of written and spoken English, a favorable recommendation from a current commanding officer and a GT score of 110 or higher.

Applicants also must have appropriate citizenship, character and leadership characteristics (see paragraphs 1-4, AR 135-100), meet the minimum physical standards currently prescribed for officer personnel (chapter 2, AR 40-501) and possess a favorable National Agency Check.

Candidates must also take the Scholastic Aptitude Test (SAT) of the College Entrance Examination Board. Results must be submitted with the application, or a statement included that SAT results will be forwarded separately as soon as possible.

Personnel accepted for the program will receive up to four uninterrupted years of education at selected civilian colleges. Graduates will be commissioned in the Medical Service Corps, with an active duty obligation of four years.

Applications must be forwarded to HQ DA (DASG-PTT-T), Washington, D.C. 20314, no later than May 15, 1972. See your personnel officer for further information.

Office of the Chief of Research and Development (OCRD), are evaluated and summarized in two recently issued reports.

Technical Research Report 1172, "Dimensions of Leadership in a Simulated Combat Situation," involves officer prediction research to meet the need for improving selection and assignment of personnel for leadership.

Findings are reported from a sample of 900 officers who went through an intensive 3-day exercise in a simulated combat situation. A trained military staff analyzed more than 2,000 single observations and evaluations while the officers performed 15 missions—five combat, five technical and five administrative.

Eight general factors in officer leadership were clearly delineated.

BESRL Technical Research Note 226 evaluates alternative procedures for preparation and input of information into an Army tactical operations system. It is titled "Evaluation of Man-Computer Input Techniques for Military Information Systems."

Comparing the accuracy and speed of two input procedures under two conditions of verification, the publication describes in detail the evaluation method and analysis.

The reports may be obtained from: RDMR-BL, 1300 Wilson Boulevard, Arlington, Va. 22209.

'The Old Order Changes' . . . More This Issue

Continuing the "transformation" announced in the January-February 1972 issue, the *Army Research and Development Newsmagazine* takes on additional changes with this edition.

Our many readers, it is hoped, will find the over-all quality standards sustained with respect to the variety and value of information we have endeavored to present during the past 11 years, and also find the manner of presentation more readable and eye-appealing.

The quality of contents appearing in the *Army Research and Development Newsmagazine*, the editors are ever mindful, depends in large measure on contributions from individuals and agencies involved in R&D activities. By-lined articles, features, news releases, and other forms of information material concerning R&D matters are still needed.

Along with our abiding gratitude for past contributions to the Newsmagazine is added the appeal to all readers for continued participation in its publication—particularly the information officers in all R&D elements.

In view of our new "slick" cover—which it is hoped will be enhanced in the months ahead by authorization to use similar coated stock for the inside pages to improve the quality of pictorial content—pictures with greater visual impact are urgently desired. Pictures suitable for full-size reproduction in two colors on the front and back covers are always in demand.

The constant purpose of the Newsmagazine is to serve the Army R&D community effectively and substantively as progressive improvements in format and content are made in the months ahead. Thanks for your continuing contributions of high-quality material.

Women in Army Science. . .

Edgewood Reports on Ladies' Achievements

Outstanding contributions of women to Army science are well exemplified at Edgewood (Md.) Arsenal in research and development activities ranging from rocket and missile propellants to methods of protecting persons exposed to toxic chemicals.

Typical of Edgewood's female scientists are Misses Ann Kunkel, Dorothy M. Ward, Virginia E. Bauer and Mary M. Demek, Mrs. Margaret G. Filbert, Mrs. Eleanor V. Crabtree and Mrs. Ethel Hackley, all of whom have distinguished themselves by achievements.

MISS KUNKEL, a research pharmacologist, and Miss Ward, a biochemist, are graduates of Notre Dame College of Maryland and are both assigned to the Edgewood Biomedical Laboratory.

In her research in the basic medical science program, Miss Kunkel, who also has a master's degree in pharmacology from the University of Maryland, was

one of the scientists chiefly responsible for development of the use of oximes to treat effects of exposure to nerve agents.

Author of more than 40 scientific and technical papers, she has studied the structure and effects of chemical compounds with which workers might come into contact. Her research has included use of various therapeutics to treat exposure patients.

Recognition came to her in the form of the U.S. Army's second highest civilian employe honor in 1969 when she received a Meritorious Civilian Service Award. She is a member of Beta Beta Beta, an honorary biological society, and has been honored by Kappa Gamma Pi and Delta Epsilon Sigma.

MISS WARD heads the arsenal's toxic information group and is the author of "Searching for Toxicological Information," published in the Armed Forces Chemical Journal in 1957. She coauthored a report on nitrogen mustards effects published in the *Encyclopedia Americana*.

In addition to earning a master of science degree from Catholic University, Washington, D.C., she has pursued studies in analytical chemistry at Johns Hopkins University and in genetics at Cornell University.

MRS. FILBERT, a research pharmacologist who has served at the arsenal since 1950, is currently employed in the Biomedical Laboratory.

She earned her BS degree in zoology and a master's degree in physiology from the University of Maryland, where she is studying for her doctorate.



Mrs. Eleanor V. Crabtree

In collaboration with a scientist from the Johns Hopkins University's division of anesthesiology, she presented a paper on "The Effects of Anesthetic Gases on Brain Enzymes" before the 1971 International Conference of Neurochemistry in Budapest, Hungary, and has presented papers at other conferences.

Mrs. Filbert is secretary of the Subcommittee on Molecular Fluorescence of the American Society of Testing and Materials.

MRS. CRABTREE, who graduated magna cum laude in the 1940 class of Rutgers University, came to the arsenal as a research chemist in 1962 and is now working in the Chemical Laboratory.

Author or coauthor of more than 25 technical publications, she has experimented with new concepts for detecting chemical agents. Her review of the Schoenemann reaction (one of the principal methods for detecting chemical agents) is regarded as a primary source of information about detection of toxic organophosphorous compounds.



Miss Anne M. Kunkel

APG Gives Zornig Award to Woman Gunner

The only woman certified as a gunner at Aberdeen Proving Ground (APG), Md., has received the Zornig Award for 1971, in recognition of her proficiency in the construction and repair of miniaturized transducers.

Mrs. Darlene J. Wilson received the award from Dr. Robert J. Eichelberger, director of the APG Ballistic Research Laboratories. The citation acclaimed her "... energetic approach to assigned tasks, her appetite for additional work and new experience, and consistent devotion to the needs of the organization at the cost of considerable personal sacrifice."

Since 1963, when Mrs. Wilson started to work at APG as a mathematics aide in the Interior Ballistics Laboratory, she has devoted much off duty time to the extension of her own skills and training. In so doing, she has successfully completed courses in mathematics, computer programming, strain-gauge techniques, and weaponry at the Ballistics Institute, at Harford Junior College, and at the Massachusetts Institute of Technology.

Her devotion to her job is illustrated by the fact that when her son, Kevin, was born in 1969, Mrs. Wilson was absent from work for only ten weeks, saying she had to "... adjust Kevin to life with a gunner for a mother."

The annual award, recognizing outstanding individual achievement in technical, mechanical, administrative, or other fields, is named in honor of COL H. H. Zornig, who was responsible for the organization of BRL in 1938, and who served as director until 1941.



ZORNIG AWARD WINNER Mrs. Darlene J. Wilson, flanked by Dr. Robert J. Eichelberger (right) and Leland A. Watermeier, chief, Interior Ballistics Laboratory, Aberdeen Proving Ground.



Miss Mary M. Demek

When she became the recipient of an Army Research and Development Achievement Award in 1969, one of the most prestigious honors for Army in-house scientists, Mrs. Crabtree was cited for discovering a fast, easy-to-use method for detecting physiologically active chemical agents.

MISS DEMEK, author of 23 technical publications, has conducted extensive studies on the analysis and decontamination of chemical agents. She is currently studying improved methods for detecting, identifying and removing impurities from water.

Graduated magna cum laude in 1936 from St. Joseph's College, Emmitsburg, Md., and she has done postgraduate work at the Johns Hopkins University.

In 1965, Miss Demek received a Department of the Army Commendation for assisting the Army Environmental Hygiene Agency on industrial control waste problems.

MRS. HACKLEY, in succinctly summarizing her efforts for 20 years as a research chemist at the arsenal states, "Our goal is to find enzymes which will be useful in detecting certain chemical agents."

Since 1951 she has been engaged primarily in developing new methods for analyzing and detecting a variety of enzymes and substrates produced in plant and animal cells which cause changes in other substances by catalytic action. In 1967 she was recognized for the sustained, superior quality and initiative of her research when she was awarded a "Quality" in-grade increase.

Mrs. Hackley is a member of a 5-man team currently investigating how certain metals affect enzymes. Other areas of her research have included enzyme induction studies, enzyme production from bacteria and experiments in enzyme purification.

She holds a BS degree in chemistry from Virginia Union University (1945) and an MS in organic chemistry from Howard University (1948).

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Miss Dorothy M. Ward

Author or coauthor of 23 scientific publications, she was commended in 1965 for the technical paper she presented to the Chemical Research and Development Science Conference held at Edgewood Arsenal. She is a member of the Research Society of America.

How much research is necessary to establish a capability of ensuring that the drinking water for American military men called to serve in any part of the world is reliably safe and desirable for human consumption?

"More than you might imagine" could be the response of VIRGINIA E. BAUER, a research chemist since 1942 at Edgewood (Md.) Arsenal. Her entire career has been devoted to providing an all-environment answer to that question.

Numerous honors have recognized her contributions to research on methods of detecting the presence of toxic agents in water and methods of decontaminating the water. One of the laudatory attributions comes from Dr. Joseph Epstein, chief of the arsenal's Defense Research Branch, who states:

"She has made invaluable contributions in the field of detecting chemical agents, not only in methods for treating drinking water supplies but also in the protection of military food supplies."

Dr. Epstein is well qualified to evaluate her research achievements since she has worked with him for more than two decades in developing methods of detecting, analyzing and decontaminating toxic chemicals in water.

In 1962 their findings yielded a new discovery in chlorine chemistry and a procedure for purifying drinking water contaminated with toxic organophosphorous compounds. In another investigation she adapted the Schoenemann test to a method of determining whether the chemical agent concentration in field water for military supplies is at a safe level for human use.

Although the chlorine is normally consumed in usual water purification processes, Miss Bauer and Dr. Arten-



Mrs. Margaret G. Filbert



Mrs. Ethel B. Hackley



Miss Virginia E. Bauer

stein found that chlorine remained unchanged after accelerating the chemical changed after accelerating the breakdown of organophosphorous compounds.

They also determined that certain toxic chemicals mixed with water decompose rapidly to nontoxic substances while others, considered to be highly toxic by inhalation, are dangerous only if consumed in large quantities.

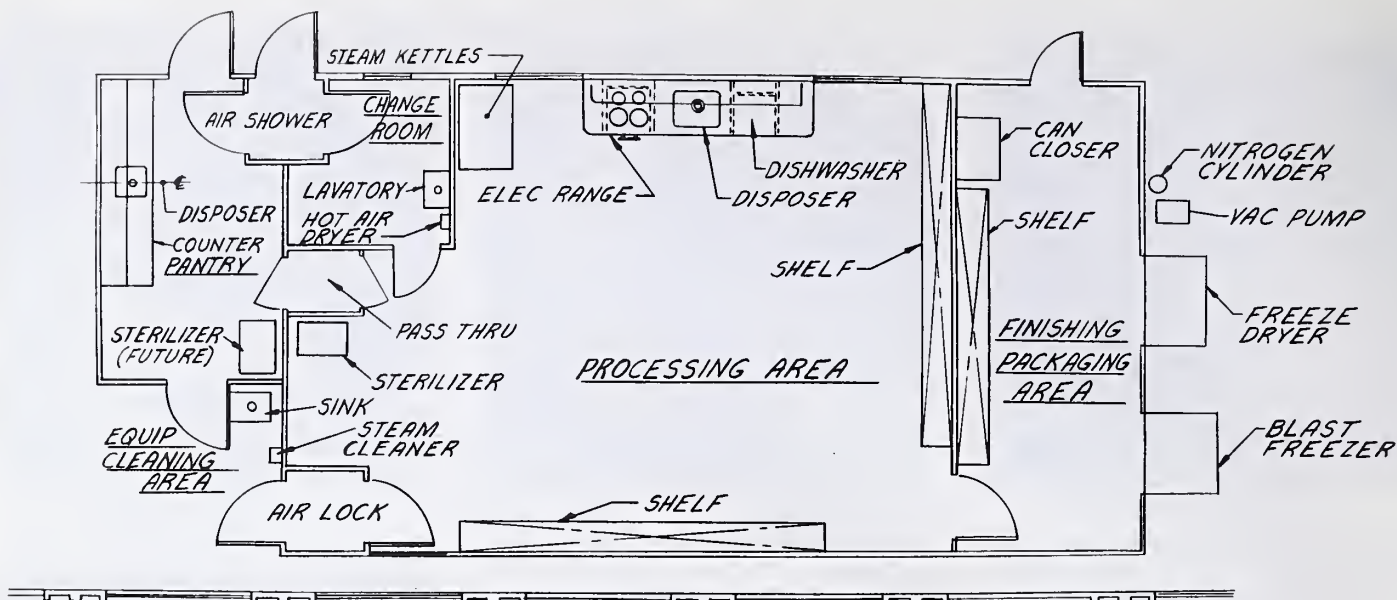


Fig. 1. Layout of Controlled Environmental Facility, U.S. Army Natick (Mass.) Laboratories.

Natick Labs Open 'Clean Room' . . .

Department of Defense, National Aeronautics and Space Administration
Cooperating in Program to Improve Food Processing, Packaging Methods

By John Swift

Joint effort by the Army, Air Force and the National Aeronautics and Space Administration is represented in what is considered a unique research and development facility at the Army's Natick (Mass.) Laboratories.

Announcement of the facility came recently with an explanation that the "Clean Room" will be used to probe new and advanced methods of food processing. It provides an environment where food can be handled without the normal hazards of microbiological contamination.

Designed for operational flexibility, the facility provides approximately 1,000 feet of floor space and is arranged as shown in Figure 1. The functional areas include:

Air Shower. This compact unit incorporates the principal features but none of the frills of a conventional installation. Filtered air is blown at about 80 miles per hour through 14 nozzles 1½ inches in diameter, to remove the dust and dirt which normally cling to a person's clothing, face, hands and hair.

Manually started by means of a push-button switch on the inside, with the period of operation set by a timer, the blowers can be stopped and the doors opened at will. No one can ever be

trapped inside because of a power failure or faulty controls.

A Change Room—this can accommodate one individual at a time for washing hands and donning a clean uniform, plastic booties, gloves, mask and hair covering.

It is a semiclean area with the conditioned air, like the pantry, being introduced through a 2 x 4-foot absolute filter in the ceiling. The air return grille is positioned to provide a down-flow pattern over a coatrack used for temporary storage of uniforms.

A Pantry area is used for storing ingredients and for mixing materials subsequently sterilized with heat. It is a semiclean area through which all food materials are transferred to processing or finishing areas.

Processing, Packaging Areas are maintained as microbiologically clean as sanitizing procedures and absolute air filtration will permit. Operations are designed to achieve or approach sterility of the food product and to prevent recontamination.

All materials are handled under aseptic conditions. Working surfaces and equipment are sanitized before use and the products are exposed to heat or laminar flow air only in front of an absolute filter unit.

Construction features are of interest

because a number of them involve the use of ordinary materials that were prefabricated and assembled much like a do-it-yourself project.

The walls are prefabricated modular units with ½-inch cement asbestos board exteriors and ⅛-inch melamine-coated hardboard interiors bonded to 2 x 3-inch wood framing.

The space in between is filled with self-extinguishing block styrofoam insulation. Fitted to level shoes anchored to the concrete floor, the modules are butted and joined by means of extruded aluminum batten strips. The wedged edges are feathered so that the strips are almost flush with the panel surface. Window areas are sealed with double panes set flush with wall surfaces. Inside corners are rounded with aluminum coving.

The ceiling is constructed of 2 x 4-foot metal-faced panels in a suspended "T" bar grid. The panels are loosely positioned in the grid on gaskets of foamed plastic tape. They are 1-inch thick with paper and fiberglass insulation sealed between thin sheet metal skins.

The floor consists of 0.090-inch sheet vinyl cemented to the concrete substrate and coved around the perimeter. The vinyl extends up four inches to butt against the melamine paneling.

Utilities include electricity (115 and

208-volt lines), steam, water, sewer drains, compressed air, nitrogen and a vacuum system. These are supplied in most cases from overhead, with the conduit, boxes and piping concealed within the wall modules.

In the few instances where it was necessary to pierce the wall, the opening around the pipe was sealed with a one-piece aluminum flange held in place with epoxy cement. Where the floor was penetrated, the space between the sleeve and pipe was sealed with silicone rubber.

Air Filtration. Three basic configurations can be used to control airborne contamination—horizontal laminar flow rooms, vertical laminar flow rooms, and rooms with horizontal or vertical laminar flow work stations. Our choice was a variation of the latter configuration since it offers maximum flexibility for experimental operations. The variation involves the use of box-type filter units positioned on shelving, separate stainless steel work tables, and the use of absolute filters in the air conditioning system.

Figure 4 shows a typical array of filter units and work positions. The advantages of this arrangement are: (1) Horizontal laminar flow air can be focused on the precise spot where food is to be handled, (2) contamination from an operator is directed away from the food, (3) housekeeping and sanitizing procedures can be performed more effectively since the shelving and tables are open underneath and since the tables can be readily moved, and (4) filter units and work positions can be arranged for any sequence of operations.

Each of the box-type filters is fitted with a 3-sided plastic shield, draped in the form of a tunnel 2 feet high and 4 feet wide. Enclosing the work area for a distance of 18 inches from the face of the filter, the shields are made of clear 2-mil-polyvinyl chloride weighted on the ends to give a wrinkle-free drape.

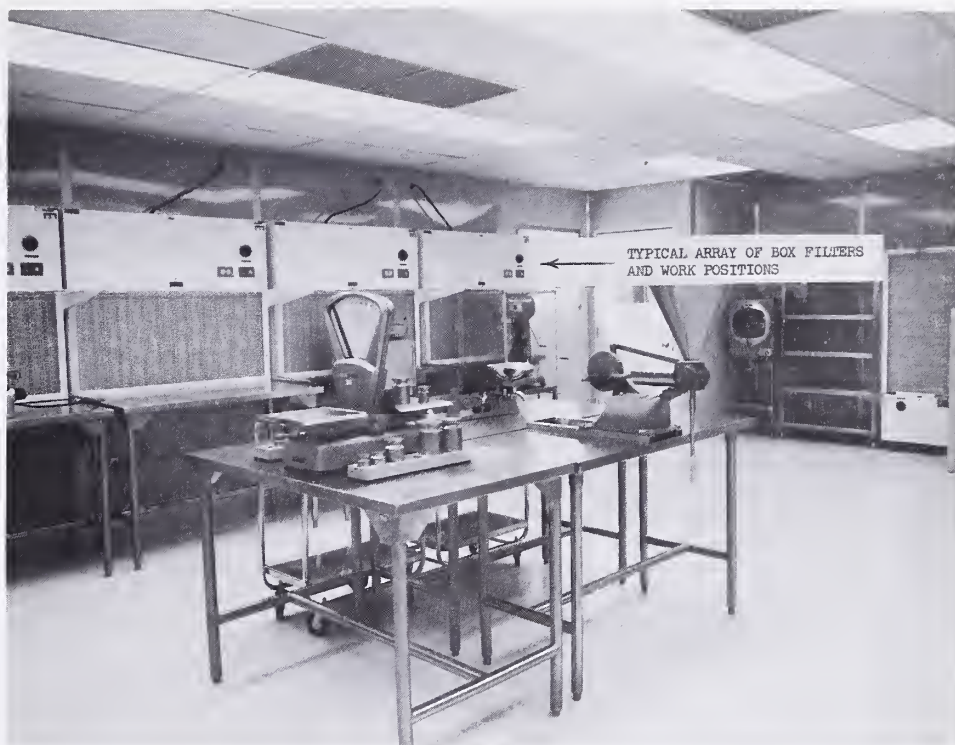


Fig. 2. Processing Area of Controlled Environmental Facility at Natick.

An advantage of the plastic shields is that they can be made to span any number of filter units so that the side-to-side dimension can be changed to suit the need.

The final media in both the air-conditioning system and box-type units are absolute filters having a capability of arresting 99.7 percent of particles 0.3 microns in size and larger. Filtered air is delivered horizontally by the box-type units as a laminar flow rate of 90 FPM and vertically through the ceiling filters in the air-conditioning system at around 110 FPM. The box-type units are equipped with variable transformers so that the desired velocity can be main-

tained as resistance of the media increases.

Air Conditioning is supplied at 74° F. at a rate of about 2500 CFM, introduced through 2 x 4-foot absolute filters in the ceiling grid. Room air is exhausted through a weighted vent at around 40 percent of the circulation rate. A separate blower and filter furnish the make-up air. The relative humidity in the finishing-packaging area is maintained at 20 percent or below.

Instrumentation consists of thermometers and hygrometers for monitoring temperature and humidity, an indicating and recording photometer to show the relative level of airborne contamination, and an inclined manometer to indicate the static pressure.

Equipment is capable of formulating, processing and packaging almost any type of food product on an experimental or pilot scale, and ranges from kitchen utensils to a 12-square-foot freeze dehydrator. Most of the items can be arranged for almost any sequence of operations or moved to other areas for cleaning and sanitizing.

In Summary, the U.S. Army Natick Laboratories now have a facility which will provide, through actual operating experience, a means of evaluating the advantages of less severe food sterilization processes. The Clean Room offers a capability for developing military rations having flavor and other quality characteristics superior to those produced under conventional conditions.

John Swift has been employed as a chemical engineer in the Process Development Division of the Food Laboratory, U.S. Army Natick Laboratories since 1963. He is a member of American Institute of Chemical Engineers, National Association of Corrosion Engineers, Institute of Food Technologists and is a registered professional engineer. He received his degree in chemical engineering from Northeastern University.



MG Sammet Reviews Prototype Concept

(Continued from page 23)

back to Congress for authority, as we must do, to reprogram FY 72 funds to get this program under way this year if at all possible. If not, it is in the FY 73 request. As you may recall, this is a multi-mode missile carried by Army aircraft for use against forward-area air defense weapons, particularly radar-controlled automatic cannon.

The *second* is *improved fire control for low-altitude air defense systems*. This is to be a 2-part effort to improve gun fire control and to procure several prototype forward-looking infrared devices to permit improved acquisition and tracking for night and low-visibility conditions for both gun and missile use. This is a candidate for FY 72 OSD (Office of the Secretary of Defense) emergency funding. If we don't get the emergency funding, we hope to start in FY 73 where money is in the program.

The *remaining FY 72 candidate* is the *remotely piloted aerial observer designation system*. The goal is a small, low-cost, remotely piloted vehicle. The idea is to have a low-cost artillery target acquisition and laser designator system to operate in forward areas where risk of loss of manned aircraft would be prohibitively high.

It is planned that the RFP (requirement for production) will be released as soon as the FY 73 appropriation bill is approved, with a dual contract planned for 60 days later for competitive airborne

subsystems. The airborne subsystem includes the remotely piloted vehicle and the integrated television sensor and laser designator.

Next, I'll summarize the *remaining five prototype programs* being included in the FY 73 budget request. There is a companion program to the one I just covered, and this is a forward-area tactical surveillance drone. The concept is for a high-performance drone prototype to provide photographic target acquisition and point surveillance out to the range of the division commander's area of influence.

It is planned to implement this prototype effort with procurement of the Canadair CL-89 surveillance drone system currently in production for the United Kingdom and Germany. This program plan also contemplates procurement of a larger "stretched" version, the CL-289, under a development cost-sharing agreement with the Canadian government.

In an effort to get work under way prior to approval of the FY 73 appropriation bill, FY 72 emergency funds have been requested from the Office of Director of Defense Research and Engineering to all program initiation this year.

Two aircraft projects are included in the proposed prototype program. *The first is the heavy-lift helicopter*. As most of you know, Boeing-Vertol was selected last fall to do an advanced technology

component development effort. We are now asking for funds in FY 73 to fabricate one actual test bed aircraft.

The purpose will be to demonstrate that the technology developed under the Boeing-Vertol contract is in hand, and that the heavy-lift helicopter satisfies the mission requirements prior to making the engineering development decision.

The second aircraft project is the tilt rotor. Earlier studies and experiments with a number of V/STOL concepts led both the Army and NASA to the conclusion that the tilt-rotor system offered the most promise for future projected requirements.

Technology has now reached the point where the tilt-rotor system is believed ready for a proof of concept test by building and evaluating two prototype aircraft. This will be a joint Army-NASA program. The RFQ would be issued in late FY 72, with the flight testing of the aircraft estimated to begin in the spring of 1975.

A new thermal sight for the M60A1 tank is also a prototype proposal for FY 73. The objective is a thermal sight to be mounted entirely within the turret and *fully integrated into the tank fire-control system*. It will provide improved capability to detect and engage targets during darkness where no ambient light exists, and during daylight in conditions of smoke or dust.

The last item on the list is classified. All I can say is that it involves improved equipment to support needs identified in an electronic warfare study.

In this connection, and it is equally relevant to each of the project proposals I have discussed, more detailed information is available in the OCRD (Office of the Chief of Research and Development) Industry Liaison Office. I'm sure many of you have visited us, but for those who have not, there is a small blue brochure at the back of the room titled "Information for Industry." On page 42 of this brochure, you will find a section that describes the necessary steps you should take to be granted access to our files.

I sincerely hope that I have given you information that will assist you in determining if any areas of potential new business exist within your companies' capability. It is in both of our interests that we cooperate to the fullest in the early solving of potential trouble spots—and that is the real purpose of experimental prototypes.

If I have alarmed anyone by my earlier comment that prototyping as a spotlighted procedure may eventually disappear—have no fear. The Army believes in prototyping and will continue to do prototyping whenever we believe it is in the interest of this nation to do so.

Mohawk OV-1 Gets Cocoon Coating in Preservation Experiment



The white OV-1 Mohawk aircraft at Sharpe Army Depot, Calif., is part of a test project to determine if it is economically feasible to preserve Army planes with a stripable coating, then keep them dehumidified by circulating dry air throughout the aircraft and its engines. Charles Tagliabue checks the humidity of the OV-1 which will be taken out of its cocoon in April following six months of preservation. The coating can be "peeled like a banana" to fly the aircraft.

ABCA Standardization Program . . .

United by a common purpose, Armies of America, Britain, Canada and Australia are applying lessons learned in two world wars to new weapons, tactics.

**By LTC Anthony C. Elcomb
United Kingdom Member, Primary Standardization Office**

Notwithstanding their common purpose—the defense of freedom—and their common language, experience over more than 50 years, including joint effort in two World Wars, has shown America, Britain, Canada and Australia—the ABCA Nations—that cooperation is no simple matter.

Involved are differences in systems and equipment, and in some areas even the language has had different interpretations. In looking back on joint combat experience, it was the will of those concerned to cooperate, rather than the standardization of language, equipment and methods, which made it possible to carry out successful military operations.

Recognition that standardization is essential to the needs of the common purpose came immediately after World War II. Discussions started in 1945 between General Eisenhower and Field Marshal Montgomery.

By 1947 a standardization program had been initiated between the ABC Armies, the United States, United Kingdom and Canada. This became the ABCA Standardization Program when the Australian Army accepted membership in January 1963. New Zealand, while not a full member, became associated with the program through Australia in 1965.

The ABCA Program was formalized in the Basic Standardization Agreement, signed by the four subscribing Armies Oct. 1, 1964. The aims of the program are directed towards:

- Ensuring the fullest cooperation and collaboration among the subscribing Armies.
- Achieving the highest possible degree of operational compatibility through materiel and non-materiel standardization.
- Obtaining the greatest possible economy by the use of combined resources and effort.

The Agreement does not imply nor require adoption of common or identical materials or methods.

The key to achieving standardization under the Agreement is the free and timely exchange of information on matters of interest to the four Armies. This is achieved through the circulation of appropriate conceptual papers, studies and national development documents for information and comment, and also during discussions with the 21 Quadripartite Working Groups.

By commenting on each other's projects, Armies are able to inject constructive criticism which can enhance operational compatibility, as well as declare the extent of their interest in the project.

An Army that has declared a real interest has access to information, within national policies for disclosure of information, on all future developments. At an appropriate stage of development, an interested Army may re-

quest the free loan of the product for its own test and evaluation.

The Agreement allows for collaboration and cooperation between the member Armies in the development of equipment to meet a common requirement. However, political, industrial and financial limitations have restricted the occasions on which these courses have been followed.

Interdependent Research and Development provides another avenue towards obtaining standardization and economy of effort under the Program when a common need has been established between two or more Armies.

By reaching agreement for one Army to develop the equipment while the other interested parties monitor that development, much duplication of effort can be avoided. At the appropriate stage, the Armies which have forgone the development negotiate with the developing country for adoption of the equipment, subject to their acceptance trials.

The Basic Standardization Agreement provides for a small permanent organization to manage the ABCA Program. Each of the four nations nominates a senior officer on duty in Washington as its representative.

Known as the Washington Standardization Officers (WSO), they are the top echelon of management, meeting as required to coordinate and expedite the program. The WSO are supported by a small full-time organization known as the Primary Standardization Office (PSO).

Staffed by representatives of the four Armies, who monitor and make recommendations to the WSO on the operation of the program, the office is a corporate international entity and its officers act as staff officers for the WSO either collectively or individually.

The Basic Standardization Agreement also provides the authority for each Army to establish Standardization Representatives with the other three Armies. For example, the U.S. Army Standardization Groups in the United Kingdom, Australia and Canada and the British, Canadian and Australian Liaison Officers in the United States are authorized under this agreement. These representatives are accredited or attached to host Army agencies as necessary and as agreed between the Armies concerned.

Much of the detailed work of standardization within the program is conducted within the 21 Quadripartite Working Groups. These working groups cover the field, ranging from the development of long-term operational concepts, through operational analysis, to common and related materiel requirements.

Composed of experts in the appropriate areas from the four Armies, the groups rotate meetings between the four countries as re-

quired. National delegations to working groups, while presenting their Army's position to the meeting, are responsible for reconciling differences, reaching agreement on Quadripartite positions and making recommendations that will further standardization goals of the ABCA Armies.

The WSO have established two committees in Washington to coordinate work under the program. The Quadripartite Research Committee, whose members have access to the scientific staffs of their own Armies, coordinates information on research matters. The Quadripartite Materiel and Agreements Committee manages the activities of the majority of the Working Groups for the WSO.

Both committees are formed from the staffs of their own Armies on duty in Washington and meet as the need requires.

The ABCA Program provides the four Armies with a unique opportunity to further their common interest and its cost is small in relation to the infinite benefits it offers. Armies have free access to information on more than 1,000 R&D projects, of which nearly 300 are in the field of research.

These projects include items such as the United States Lance Missile System, British RAPIER Air Defense System, the Canadian Airborne Drone Surveillance System and the Australian Short-Range Radio.

The extent of the free loans of equipment is far greater than realized and covers a wide field, such as the British Chieftain Tank to the United States and the recent request from Australia for the United States Medium Tank, M60A1.

These are tangible benefits of the program. Less apparent, and impossible to assess, is the value that each Army receives by way of advice, comment and ideas resulting from the wide and varying experiences of the individual members.

Experience during the first half of the Twentieth Century has demonstrated the need for standardization among the ABCA Armies. The Basic Standardization Agreement has recognized this need and provided Armies with a program which can lead to greater operational compatibility through standardization.

This Agreement also opens the door to economies in defense expenditures through the mutual exchange of information and the opportunities for cooperative, collaborative and interdependent research and development.

The foundation for closer cooperation have been well laid. The quality of the structure that is built on those foundations will depend on the will and sincerity of Armies and the attitudes of their staffs.



SPEAKING ON . . .

Future Trends, Goals in Research and Development

(Continued from inside front cover)

those the Army itself has proposed, are directed ultimately toward the objective of reducing program cost.

We have entered an era where large-scale funds for development will be released only after we have proven out actual components in the fly-before-you-buy approach.

Lastly, there are such side factors as the SALT (Strategic Arms Limitation Talks), internal political decisions and executive decisions on a variety of issues, such as the draft and employment levels. All can impinge on the content and direction of the future R&D program.

Now, with those four factors as a frame, let's look at our progress and trends. I'll start with the technological base.

Efforts to maintain the technology base have historically received about 8 percent of our total research, development, test and evaluation (RDTE) budget. It has been the hardest part of our program to justify, for there frequently is no end product in view. But we must have sufficient support for three key reasons:

- The is the source of new systems—new capabilities.
- It provides knowledge for the Army to be a knowledgeable buyer in the technology market place.
- It provides an intelligence yardstick with which to measure foreign technological progress.

As I mentioned a moment ago, we lost some ground here during Vietnam. We are aiming at recouping our position, but justification remains a problem, with demonstrable relevancy a key factor in formulating and justifying R&D programs for support.

What are some of the things we are looking at in this technology base area? An excellent example of this research technology at work is in our endeavors to lengthen the storage life of human blood for medical purposes. We have found no satisfactory substitute for whole blood as an oxygen carrier to the tissues. The present very limited shelf life for whole blood of 21 days is a very expensive cost, estimated at \$4.5 million since 1969.

Laboratory demonstrations, however, have indicated that doubling the shelf life is feasible by adding certain naturally occurring substances. Current studies are evaluating the safety of these additives. Within two or three years, data will be in hand on the toxicity of the additives and other factors necessary to obtain approval for human use.

Another project that offers considerable potential is termed ARMIDOP—an acronym for artillery missile doppler. It is a new and unique technique that shows potential for accurately and rapidly determining the relative positions of personnel and equipment in a tactical environment.

ARMIDOP should eliminate the serious problem of the forward observer who does not know where he is in relation to his artillery support. The concept depends upon the transmission of a doppler signal that might be obtained from the high-velocity transmitter section of an artillery projectile fuze.

There is an active program to improve our camouflage techniques. It was discovered recently that military paints and fabrics glowed when illuminated by pulsed laser light, somewhat like the results when "black light" is shown on materials.

This is a 2-edged sword that tells us our people can be seen by such a method. But we can also detect the other fellow by the same means. Some uniforms were detectable to almost a mile.

However, we have determined that this luminescence can be minimized by the presence of certain inhibiting substances. Our objective is to identify suitable inhibiting agents for the dyes and pigments used in Army clothing and equipment.

There are a number of other ongoing R&D efforts that I could describe if I had the time, things like photogrammetric work to improve efficiency of forward observers (FOs) in the artillery role.

Tests to date indicate that significant improvement could be expected by optimizing the graphic materials in the process,

training the FOs to use them, and making relatively minor improvements to the hardware components. There are many others, but I believe these will serve to illustrate my point.

The second major category of our budget I am going to mention is the one that has consistently taken the biggest single piece of our RDTE dollar. Roughly 30 percent yearly goes into strategic and joint programs. This pattern would seem to remain for the foreseeable future.

Included here are the operation of the joint missile ranges at Kwajalein (an island test site in the Pacific) and White Sands (N. Mex.) and ballistic missile defense R&D.

Progress in ballistic missile defense R&D has provided the Army with the capability to deploy the Safeguard System—a system that is based on technology which has been proven in the course of Safeguard System development.

Current and future Safeguard R&D efforts are being directed toward such things as developing improved terminal defense and area defense—both components and systems. We are working on a new advanced data processing—both hardware and software, to provide a capability for increased target handling and better discrimination.

We are devoting considerable efforts toward solid-state radars that provide high reliability with reduced size and power requirements. And naturally, we are looking at a new interceptor missile technology.

In light of the continued threat—the other fellow's capability, not his intentions—we have to continue to devote considerable sums of money to the Safeguard segment of our R&D program.

Of major interest perhaps, to most Army followers, is the category of Army tactical developments. This is the segment that contains those development programs that support tomorrow's soldier in the field.

The program of 5 to 10 years ago, and to an extent of today, reflects the tactical threat we were being asked to counter in the emphasis on antitank weapons. The TOW system has begun to reach the field, Shillelagh is in the field, and Dragon is nearing completion of R&D.

Our antitank capability now extends to thousands of yards with a high order of first-round hit probability. We have increased our capability perhaps threefold. This is the product of the technology base efforts of the late 50s and early to mid-60s.

Part and parcel of the threat were our efforts to develop a new main battle tank that would be significantly superior, to offset anticipated enemy numerical disadvantages.

Here we came face to face with an ever-increasing problem, born of the new technological revolution. Increased capability means increased sophistication, and increased sophistication means increased costs.

In the case of the new tank, the Congress recently determined that the XM803—the austere successor to the joint United States-Federal Republic of Germany Main Battle Tank program—was still too costly, and directed us to seek alternate approaches.

Vietnam experience confirmed the airmobile concept, and studies indicate the concept will work in a sophisticated European environment, with some modification.

The future trend then, for the next 5 to 10 years, in tactical developments will see us experimenting with new technology to develop new systems for the 1980s. We are entering a period similar to a decade ago.

Air mobility is a good example. The new heavylift helicopter and the follow-on lift ship to the Hueys—the so-called UTTAS—are programs that will be applications of the new technology of the late 1960s and early 1970s.

A program to raise the capabilities of the aerial Scout helicop-

ter is another example. Here we plan to exploit new technology in such areas as position fixing and navigation and night-vision capability.

Indicative of this pattern are the two new surface mobility programs that are just now starting, the Mechanized Infantry Combat Vehicle (MICV), to replace the M113, and the Armored Reconnaissance Scout Vehicle to succeed the aging M114 fleet.

Both programs use a blend of an evolutionary approach, with some technology breakthroughs, to attain the desired increase in battlefield cross-country mobility. Major advances in suspension system technology, evolutionary improvements in engine and transmission, and in lightweight materials will be used in the MICV and the ARSV.

Our weapons programs will be directed toward improvements in three areas: (1) improved guidance systems that will increase greatly the probability of first-round hit, (2) improved conventional-first-round hit warheads, and (3) increased range for artillery and mortar projectiles.

For example, we are looking toward fire-and-forget type anti-tank missiles for both helicopter and ground employments. These are missiles that do not have to be flown all the way to the target. They find the target by terminal-homing technologies now under investigation.

We must develop a workable real-time automated system to coordinate, integrate and present to the commander the new immense flow of intelligence obtained by new technological devices and systems—along with a variety of operational responses available to a commander.

The Congress gave us a fairly good part of what we requested for this effort (\$15 million for TAC ADPS), so we expect to be able to provide the people at Project Modern Army Selected Systems Test, Evaluation and Review at Fort Hood with some experimental hardware to start actual testing to resolve interface, operational and engineering problems.

What does this add up to collectively? It means that we are entering an era of stabilized R&D budgets, at best. We will try to refill our technology bank, though we will be handicapped in trying to make up lost ground. Because of fund limits, and the growing number of technological options being offered, we will have to be very selective early in the game.

New developments will tend to be evolutionary rather than revolutionary. R&D costs will continue to remain high, and

probably continue to rise due to the increased demands for increased capability. This means considerably more attention to reliability, availability and maintainability.

Human engineering will be evident early in the game. We cannot afford, in the future days of reduced manpower, the large support and maintenance forces that graced our past wars.

We will undoubtedly have problems, but stretching out will reduce the number of mistakes—though necessitating some increase in costs and lengthening the time-to-field. I do not see any dramatic surprises in the future, but I do see steady progress.

We do not anticipate development of a new missile system that will render the cannon obsolete, or technological advances in air mobility that will cause the ultimate mission of the soldier—to fight on and hold the firm earth beneath his combat boots—to be changed in the least.

We of Army R&D maintain one constant guide in mind in all of our efforts. We are acutely aware that our ultimate combat weapon is the soldier himself. Everything we develop is aimed at giving this individual soldier the best tools the mind of man can devise to assist him in performing his combat role.

We aim to provide him better protection, and to assure him we will give him the best physical and moral support possible. We do not intend that he will have to tell his children an enemy ever confronted him with a technological battlefield surprise.

Army Opens ROTC for Women

Secretary of the Army Robert F. Froehlke announced recently that the Army will offer its college-level ROTC program to women in the 1972-1973 school year.

A test program will begin this fall with women enrolling in approximately ten institutions currently offering the 4-year program.

Although women were previously not permitted to receive a commission through Army ROTC, about 160 female students at 49 institutions are now taking ROTC courses on an elective basis. Traditionally, the ROTC has provided a substantial number of officers trained as scientists, engineers and administrators for the Army Research and Development Officer Program.

The new ROTC test program will help satisfy projected needs for female officers in the Army's Reserve Components and could provide a base for rapid expansion of the Women's Army Corps.

Korean Defense Communications Adds 240 Channels to Network

An increase from 360 to 600 channels and installation of new technical control facilities at six sites are included in upgrading the Korean Wideband Network (KWN), scheduled for completion in November.

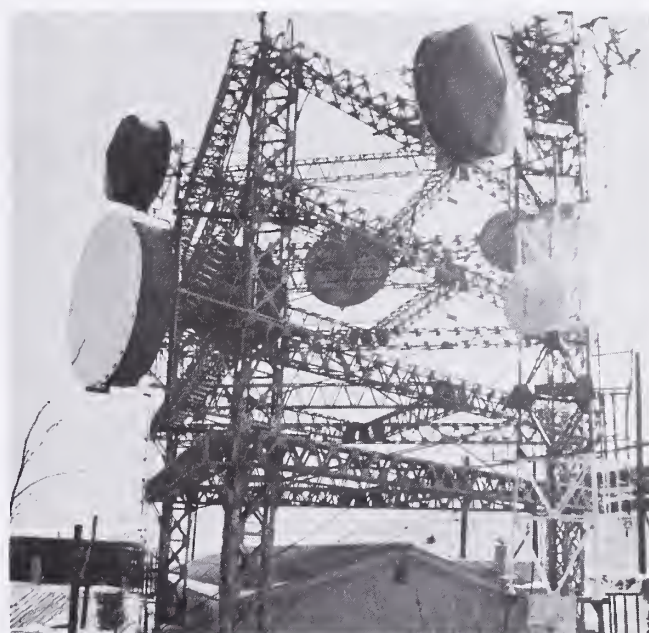
Described as the U.S. Communications backbone in Korea, the KWN spans 240 miles with land-lines, VHF radio and military/commercial micro-wave tropospheric-scatter radio systems.

As part of the U.S. Defense Communications System (DCS), the network is made up of a DCS mainline subsystem of 15 sites that interconnect with subsystems to support the Korean Army and Air Force.

Approved by the Secretary of Defense in 1969, the KWN program is designed to provide communications requirements through selective improvement of U.S. systems and the expansion and integration of Korean military systems.

During the first phase of upgrading, completed in January 1971, 10-year-old equipment was replaced by transistorized equipment made available through reconfigurations of the Integrated Communications System—Southeast Asia.

The U.S. Air Force is assisting the Korean Air Force upgrade its system that will be linked to the KWN. STRATCOM—Pacific's Communications Electronics Engineering Installation Agency is responsible for systems engineering, while the STRATCOM Communications System Agency at Fort Monmouth, N.J., is the over-all manager for the project.



TYPICAL of equipment used to upgrade the Korean Wideband Network is the antenna array in Republic of Korea.

BG Daniel Selected as Director of Army Research

Director of Army Research BG Charles D. Daniel Jr. took that title Apr. 3 when he reported for duty following return from an assignment as deputy CG of the Korean Support Command.

BG Daniel's assumption of duties was part of a series of related key personnel changes within the Office of the Chief of Research and Development, in which he served from July 1968 until January 1971. He was chief of the Nuclear, Chemical and Biological Division until he became Director of Missiles and Space in June 1970.

Graduated from the United States Military Academy in 1946, BG Daniel studied under the U.S. Army advanced education program to receive his master's and doctoral degrees from Tulane University, the latter in 1968. He is also a graduate from the Industrial College of the Armed Forces.

Following 1964-66 duty as chief of the Nuclear Branch, Defense Atomic Support Agency, he commanded the 2d Battalion, 33d Artillery, 1st Infantry Division in Vietnam, and served as division CO. His combat record includes service in the Korean War as artillery battery commander in the 3d Infantry Division.

His military honors include the Silver Star, Legion of Merit, Distinguished Flying Cross, Bronze Star with 4 OLCs, Air Medal with 16 OLCs, Joint Services Commendation Medal,



BG Charles D. Daniel Jr.

Army Commendation Medal and the Republic of Vietnam Cross of Gallantry with 2 Silver Stars.

COL Norman R. Rosen, who served as acting Director of Army Research since the departure of BG George M. Snead Jr. Nov. 8 to become deputy CG of the U.S. Army Strategic Communications Command, has returned to his position of Assistant DAR and CO of the Army Research Office.

COL Wallace H. Hubbard, acting Assistant DAR since Nov. 8, moved into that assignment after serving as acting chief of the Environmental Sciences Division following the death of Dr. Leonard S. Wilson in December 1970. His new assignment is chief of the Research Technology Division.

COL Richard A. Rooth, chief of the Research Technology Division since mid-1970, is now reassigned as director, Manpower Resources Research and Development Center (ManRRDC).

COL Douglas W. Poage Jr., director of the ManRRDC since its inception in January 1970, departed for an assignment as deputy chief, Physical and Engineering Sciences Division. He succeeded COL Florian O. Cornay, now professor of Military Science at Seattle (Wash.) University.

Morton H. Marks departed from the Information Systems Office to take over as director of the U.S. Army Management Systems Support Agency (USAMSA). Since 1967 he had served in the Scientific and Technical Information Division until it was redesigned the Information Systems Office in mid-1970. He then became deputy chief of ISO and director of the Army R&D Information Systems Office (ARDISO).

Other recent changes within OCRD:

LTC Robert V. Dennis is the new chief of Critical Projects, STANO Division. He recently returned from Vietnam where he served with the Field Unit of the Advanced Research Projects Agency, Office of Defense Research and Engineering, progressively as project officer, division chief and deputy director. He attended the U.S. Navy Post Graduate School in Presidio, Calif., from September 1968 to December 1970, receiving a master's degree in operations research. From February 1968 to September 1968 he served on the U.S. Army Artillery Board, Fort Sill, Okla., and was chief of the Missiles Division. He graduated from the Armed Forces Staff College in 1968 and was assigned to HQ U.S. Army Europe, where he served as staff officer with the Military Operations.

He has received the Army Commendation Medal (ARCOM), Bronze Star (BSM) with Oak Leaf Cluster (OLC), and the Vietnamese Distinguished Service Medal.

MAJ Bernard P. Manderville, Jr. has been assigned to

the Research Technology Division, after serving in Thailand as logistics adviser Detachment III, U.S. Army Advisory Group (1970-71).

He served in OCRD from February 1969 to June 1970 as a staff officer in the Army Research Office. In 1965-66 he was in Vietnam as a technical intelligence officer, J-2, HQ U.S. Military Advisory Command. With the U.S. Army Missile Command, Redstone Arsenal, Ala., from September 1963 to February 1965, he was an R&D coordinator.

MAJ Manderville has received the ARCOM, the Joint Service Commendation Medal (JSCM), and the Meritorious Service Medal (MSM).

MAJ Richard K. Queeney, newly assigned as a staff officer in the Operations office, U.S. Army Advanced Ballistic Missile Defense Agency, (USAAABMDA), graduated in 1971 from the University of Texas with an MS degree in aerospace engineering.

He was test project officer, Air Defense Materiel Directorate, U.S. Army Test and Evaluation Command (TECOM), in 1969-1970, following duty with the U.S. Army Pacific as battalion executive officer, 273d Assault Helicopter Company, 222d Combat Support Aviation Battalion, and assistant S-3, HQ and HQ Command, 222d Combat Support Aviation Battalion.

MAJ Queeney holds the BSM and 18 Air Medals.

CPT Samuel C. Shiffett, who has a doctorate from the University of Illinois in social psychology, is assigned to the Social Change Branch, Motivation Division, Motivation and Training Laboratory, Manpower Resources Research and Development Center.

He has attended the Army Medical Department Officer Basic School at Fort Sam Houston, Tex.

CPT Shiffett has served as a research psychologist with the Experimental Psychology Division, U.S. Army Medical Research Laboratory, Fort Knox, Ky., and as a research assistant and teaching assistant with HQ Fifth Army, Fort Sheridan, Ill.

He has authored two articles, "Group Performance as a Function of Organizational Structure and Task Difficulty," and "Situational Engineering: The effect of Changing Leader Power," both published in Organizational Behavior and Human Performance.

Laird Announces Malkin As DASD (Intelligence)

In announcing establishment of a new position of Deputy Assistant Secretary of Defense (Intelligence) for Technical Evaluation, Secretary of Defense Melvin R. Laird selected Dr. Myron S. Malkin as the first incumbent.

The position gives him responsibility for determining the objectives and the adequacy of present and planned technical programs in the areas of national, strategic and tactical intelligence.

Until sworn into office Feb. 16, Dr. Malkin was president and a director of NUS Corp., Rockville, Md., a multi-divisional engineering and consulting services firm.

He was program manager and then general manager of the Manned Orbiting Laboratory Program for General Electric Co., following duty with this firm as program manager for the Minuteman III and Titan II missiles.

Graduated from Yale University in 1948 with highest honors and a BS degree in physics, Dr. Malkin received a 1949 MS degree and a 1951 doctorate in physics, from Yale.



Dr. Myron S. Malkin

Sullivan Succeeds Rechlin As Principal Deputy DDRE

Principal Deputy Director of Defense Research and Engineering became Leonard Sullivan Jr.'s title when he was sworn in Feb. 16 to succeed Dr. Eberhardt Rechlin, new Assistant Secretary of Defense for Tele-communications.

Deputy Director for Southeast Asia Matters, ODDR&E, since 1966, Sullivan was first appointed as assistant director, Combat Systems. ODDR&E was reorganized Sept. 20, 1965, and he was appointed assistant director, Tactical Systems Review and Analysis.

From 1960 until 1964, he was with Grumman Aircraft Corp. as chief of preliminary design and then as manager of advanced systems. His work with Grumman began in 1948.

Born in New York City in 1925, he was graduated from the Massachusetts Institute of Technology with BS and MS degrees in aeronautics in 1949, and an aeronautical engineer degree in 1950. He served in the enlisted ranks of the Marine Corps, 1944 to 1946.



Leonard Sullivan Jr.

WES Uses Mini-Vehicles To Predict Performance Upon Variable Terrain

Mini-vehicles are substituting effectively for prototypes in tests to predict performance of tanks, trucks and the Gama Goat over irregular terrain at the U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss.

Using self-propelled scale models, researchers are considering the design of military vehicles to perform satisfactorily in nearly every extreme of the environment.

Obstacles such as ditches, logs and steep inclines are constructed on a large table to form the terrain features over which the mini-vehicles must move. When the mini-vehicles are stopped by the obstacles, researchers determine why and what must be done to permit continued movement.

Tests are expected to shed more light on the configuration, traction, and other drive design and power factors necessary to maneuver over boulders, climb banks, span ditches, and keep moving in spite of obstacles which might be encountered during military operations.

Researchers report that results of pilot tests to date with the three scale-model vehicles indicate that they can be used to determine obstacle-vehicle geometry interference at a fraction of the cost and time required for prototype testing.



MINI-VEHICLES are being used to predict performance of tanks, trucks and the Gama Goat at the U.S. Army Waterways Station. In the test shown above, the tank clears an obstacle by changing the approach, but will not get much farther; the truck lost the use of two wheels; and the Gama Goat negotiated all course obstacles.



TANK is stopped again, but for a different reason—lack of traction, a situation remedied by providing a rougher surface of test terrain.

SHAPE of the ground or of the vehicle may be the key factor in obstacle interference. Below, the ditch is too narrow to span, showing that both vehicle configuration and spacing of obstacles interfere with movement of the tank.



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